TECHNICAL SPECIFICATIONS

- Detailed technical specifications shall be as in KBS (Karnataka Building Specification (KBS) furnished along with the Schedule of Rates of Karnataka Public Works Department 2011-12. The items which are not covered under this shall be referred in National Building Code (NBC).

- Technical specifications for some item of works are detailed below for ready reference.

SECTION – I

EARTH WORK

1.0 INDIAN STANDARD

Work shall be carried out to Indian Standards and Code of Practices, in absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the officer incharge for his direction /approval. However as a general rule more stringent specification shall take precedence.

(1) IS 1200 Method of measurement of Building and Civil Engineering works.

(2) IS 1498 Classification and Identification of soils for general engineering purpose

(3) IS 2720 Method of test of soil

(4) IS 3764 Safety code for excavation work

(5) IS 4081 Safety code for blasting and related drilling operation

(6) IS 6313 Part 1 Code of practice for anti termite measures in buildings: Constructional measures.

Part 2 Code of practice for anti termite measures in buildings: Pre constructional chemical treatment measures

(7) SP 27 Hand book of method of measurement of building works

(8) Explosive Rule 1940

2.0 SITE CLEARANCE

2.1 Prior to the start of any activity of earthwork, the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, trees and saplings of girth upto 30 cm measured at a height of 1 metre above ground level. All rubbish must be removed and stacked at a distance of 50m outside the periphery of the area under clearances or location as decided by the officer Incharge

2.2 The rate of such clearance is to be included in the rate of other earthwork items and no separate rate shall be paid.

3.0 SETTING OUT

3.1 The contractor shall prepare detailed setting out drawings based on the layout of Architectural drawings and those shall be submitted to the Incharge prior to commencement of work. Bench Marks and Reference Lines shall be established, by the contractor with approval of the Incharge

3.2 The contractor shall do the setting out with the use of theodolite and like instruments at site, based on details given to him. He shall erect timber profiles, masonry pillars, burjis, etc. for his use. All markings on these shall be painted with red colour and they shall be maintained for the entire duration of the project. Setting out shall be approved by the Incharge before the commencement of any work.

3.3 The rate for the earthwork items shall include expenses for all such work including labour, material and equipment/ instruments, etc. No additional payment shall be eligible on this account.

4.0 EXCAVATION IN SOILS

4.1 Excavation over area

Excavation exceeding 1 m in width as well as 10 sq m in plan and 30 cm in depth shall be considered as excavation over area.

4.2 Surface dressing

Trimming of natural ground, excavated surfaces, and filled up areas to remove vegetation and/or small inequalities not exceeding 15 cm in depth shall be described as surface dressing.

4.3 Rough excavation

Excavation not requiring dressing of sides and bottom and reduction to exact levels, such as winning earth from borrow pits, hill side cuttings, etc. shall be described as rough excavation.

4.4 Surface excavation

Excavation exceeding 1 m in width as well as 10 sq m on plan but not exceeding 30 cm in depth shall be considered as surface

4.5 excavation.

Trenches for pipes/cables

It shall be detailed with nominal dia of pipe/cable. Required bottom width, allowance for concrete foundation for laying pipes, working area, grip required for socketed pipe, return fill, ramming and removal of surplus soil shall be part of this item unless otherwise specified. It shall generally be measured in cubic metres unless specified specifically as running meter in the BOQ.

4.6

Post holes

Independent post holes (or similar holes) each not exceeding 0.5cum shall generally be enumerated. Rate shall include return fill, ramming and removal of surplus soil. However this shall be in

4.7 cubic meters as part of excavation items.

4.7.1 General

The excavated earth, shall be thrown or disposed off beyond 50 m periphery of the building. Earth suitable for backfilling shall be stacked separately.

Subsequent disposal of the surplus and unsuitable material shall be

4.7.2 as per the respective items. Foundations, trenches shall be dug out to the exact dimensions as shown in the drawings or as directed by the Incharge

In firm soil, the sides of the trench shall be kept vertical upto a depth of 2 m. If the trench is to be deeper, it shall be in the form of

4.7.3 steps of 50 cm, at every 2m depth. This shall be suitably increased or decreased as per site conditions and type of soil met with. This shall be to the approval of the Incharge. Sloping of sides also may be adopted.

The bed of trenches shall be firmly consolidated and leveled by watering and ramming of the soft soil. Defective spots shall be dug out and filled with concrete of the same mix as of PCC or as directed by the Incharge. Cost of digging and filling with concrete

4.7.4 shall be paid extra if excavation and PCC is measured separately.

If excavation is done to a depth greater than that required, excess depth shall be back filled with the same mix as of PCC or as directed. Cost of such concrete shall be to the contractor's account. Excavated trenches shall have to be approved by the INCHARGE prior to laying of PCC or any other Permanent Work.

4.7.5 Excavation for drains shall be carried out with extra care to cut the sides and bottom exactly to the required shape, slope and

4.7.6 gradient.

Filling for excess deeper excavation shall be done at the contractor's cost in consultation with the Incharge Excavated materials shall not be placed within 1 m of the edge of the trench

4.7.7 or half the depth of the trench, whichever is more.

Excavations for column footings shall be carried to depths indicated in the drawings. Safe bearing capacity at such depth shall be verified to comply design requirements. If ordered by the

4.8 Incharge, appropriate tests shall be carried out by the contractor.

4.8.1 Protection

Fencing and/or other suitable measures for protection against risk of accidents due to open excavation shall be provided by the contractor at his cost.

4.8.2

Where excavation is to be carried out below the foundation level of an adjacent structure, and to avoid underpinning, precautions such as shoring and strutting, etc. must be taken. No excavation should start till such measures are taken to the satisfaction of the Incharge. Payments for such work shall not be made separately

5.0 unless specified otherwise.

5.1

EXCAVATION IN SOFT ROCK

This shall be carried out by crowbars, pickaxes or pneumatic drills

5.2 or any other suitable means. Blasting may be permitted if the contractor so desires but no extra money shall be paid for blasting.

6.0 Measurements shall be in cubic meter.

6.1

6.1.1 Other general details same as clause 4.7. and its sub clauses.

EXCAVATION IN HARD ROCK

General

On meeting hard rock that requires blasting, the contractor shall

6.1.2 inform the Incharge On approval in writing, blasting operation shall start if the contractor feels it necessary and so desires.

The contractor shall obtain the necessary license from the District Authorities for undertaking blasting work and explosive storing as per Explosives Rules 1940, and as updated. Explosives shall only be procured from an authorised dealer. He shall be responsible for

6.1.3 the safe custody and proper accounting of explosives. The Incharge shall have access to the store.

6.1.4

The contractor shall be responsible for any accident to those

6.2 working on the site, to the public or to property due to blasting

6.2.1 operations.

Measurements shall be in cubic meter by stacking rock and

applying predetermined deduction for voids.

Precautions

6.2.2 Safety measures to be adhered to shall be as detailed in IS 4081, Safety Code of Blasting (as amended from time to time, and to related drilling operations). Also digest No.37 of C.R.R.I and I.R.C.A. Road tariff No.18 shall be adhered to.

Blasting operation shall be carried out under the supervision of a responsible authorised agent of the contractor. Timings shall be as approved by the Incharge in writing. Lunch break will be preferred. The authorised agent of the contractor should be well conversant with the rules and regulations of blasting operations. Further the contractor shall employ licensed blasters for actual operation.

6.2.3 All proper precautions for safety shall be taken. All persons shall be moved away to a distance not less than 200 m. All entries shall be sealed and red flags displayed at prominent places.

6.2.4 Blasting shall be done only with gunpowder. Dynamite, gelignite, or any other high explosive shall be used only with written permission

6.2.5 of the Incharge.

The number of charges to be fired and the actual number of shots heard shall be counted and the contractor's agent shall satisfy himself by examining that all charges have exploded. Only then shall workmen be allowed to start work. Unexploded charges shall

6.2.6 be flooded with water, a new hole drilled and exploded again.

The Incharge shall be informed about all misfires, their causes and the remedial steps taken.

7.0 CLASSIFICATION

7.1 All soils comprising any of the following :

Vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum.

(b) Any mixture of soils in (a).

(c) Mud concrete below ground level.

(d) Generally any material which yields to the ordinary application of a pickax and shovel or to phawra, rake or other ordinary digging implement and not affording resistance to digging greater than mentioned in (a) to (c).

Stiff heavy clay, hard shale, or compacted murrum requiring close application of a grafting tool or pick or both and shovel.

Gravel and cobblestone (cobblestone is a rock fragment), usually rounded, having maximum dia in one direction of 75-300 mm.

7.2

Soft rock comprising any of the following

(a) Soling of roads, paths, etc. and hard core.

(b) Macadam surfaces of any description (water bound, grouted,

tarmac, etc.)

Lime concrete, stone masonry, in lime mortar and brick work in lime or cement mortar, below ground level.

Soft conglomerate, where the stones may be detached from the matrix with picks, crow bars, wedges, etc.

Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with a crowbar.

Unreinforced cement concrete which may be broken up with crowbars or pickaxes and stone masonry in cement mortar, below ground level.

Boulders not requiring blasting, rock fragments usually rounded by weathering, disintegration and exfoliation or abrasion by water or ice, having maximum dia length in any direction of 500 mm, found loose, embedded, etc.

Other varieties of rock which would normally be removed with pick, crowbars, wedges and hammer with only a little difficulty.

7.3 Hard rock comprising any of the following

Any rock or cement concrete in excavation for which the use of mechanical equipment or blasting is required.

(b) Reinforced cement concrete.

(c) Boulders bigger than 1/2 cubic meter requiring blasting.

Hard rock as in (a) to (c) requiring blasting but prohibited from doing so for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

8.0 FILLING

8.1 Filling shall be done where required with approved quality of earth. It may be from excavation and, where possible, cutting and filling shall be done simultaneously to avoid double handling.

8.2 Filling shall be done in layers not exceeding 15 cm in depth. Earth used shall be free from roots, grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 95% Procter density. Consolidation shall be done by mechanical roller of minimum 12 tonnes weight. The roller shall pass a minimum of 10 runs evenly to achieve dense consolidation. All undulation made up and final layer re-rolled.

Measurement shall be for compacted volume in Cubic Meter.

8.3

Sand filling

The sand shall be free from any organic and deleterious materials as detailed in IS. It should be suitable for compaction. Filling shall be in layers of 15 to 20 cm watered with optimum moisture content

and mechanical rammers.

8.4

Measurement shall be for compacted volume in Cubic Meter.

Rubble soling

Good quality 150 mm to 230 mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100 mm for 150 mm thick soling and 150 mm for 230 mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes, pegs at suitable intervals (about 12m) shall be fixed.

Soling shall be watered and again packed with sand or murrum to fill interstice's created by watering. Then it shall be rolled with 10 (on roller or vibratory compactor. Filling sand or murrum, watering and rolling shall continue till full compactness is achieved to satisfaction of the Incharge.

Measurement shall be in Square Meter.

9.0

PLANKING AND STRUTTING

In case of deep trenches where the soil is soft and not capable of being retained without the help of support, planking and strutting as required shall be carried out. It shall be the responsibility of the

10.0 contractor to take steps to prevent slide/collapse. Method of

10.1 planking/strutting will be largely influenced by the type of soil encountered and as approved by the Incharge.

DISPOSAL OF SURPLUS EARTH

Surplus earth shall be used to the maximum extent in the compound. Earth useful for filling shall be separately stacked as directed by the Incharge from time to time.

Approved quality earth shall be used in the filling. It shall be consolidated as detailed and approved by the Incharge.

10.2 Rate for excavation shall include sorting out of useful materials.

10.3 All surplus and unusable earth shall be disposed off outside the plot but at a location approved by local authority and conforming to their specification. The contractor shall quote his rate for disposing off or carting away the items considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

11.0

DEWATERING

Bailing or pumping out of water that may have accumulated due to rains, subsoil seepage, or any other means shall be carried on continuously and the area shall be kept dry for the following operations:

(a) Measurements

(b) Concreting or masonry work

(c) Shuttering and reinforcement

(d) Backfilling

(e) Line out

12.0 (f) Any other reason deemed fit by the In charge.

12.1

MEASUREMENT

The following shall not be measured separately and allowance for the same shall be deemed to have been made in description of the main item.

(a) Setting out works, erecting profiles, etc,

(b) Site clearance such as clearing of shrubs, brushwood, small trees not exceeding 30 cm in girth measured at one meter above ground.

(c) Unauthorised battering or benching of excavations.

(d) Forming (or leaving) DEAD MEN or TELL-TALES in borrow pits and their removal after measurements.

(e) Forming or leaving steps in the sides of deep excavations and their removal after measurements.

(f) Excavations for insertion of planking and strutting.

(g) Removing slips or falls in excavations.

(h) Dewatering by bailing or pumping out of water in excavations

12.2 from rains, sub-soil water, tides, undercurrents, etc.

(i) Slinging or supporting pipes, electric cables, etc. met during excavation or while carrying out any other item of work.

(j) Dressing, trimming of sides, leveling, or grading and ramming of bottoms.

Sooi Soils, soft rocks, hard rocks shall be measured as per SP 27 Part I except for the followings :

(a) Filling shall be in cubic meter for consolidated volume. The lift shall be considered from made-up ground level.

(b) Planking and strutting required to be left in position shall be measured separately. Incharge's permission in writing shall have

to be obtained for this. In no other case shall payment be made for planking and strutting, if carried out.

(c) Lead and lifts shall be as per the BOQ.

SECTION-II A

CONCRETE WORK

GENERAL

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices, in absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies /conflict noticed shall be directed to the Incharge for his direction / approval. However as a general rule more stringent specification shall take precedence.
Specification for Ordinary and low heat, portland cement Specification for 43 grade ordinary portland cement Specification for 53 grade ordinary portland cement

(1) IS 269 Specification for Ordinary and low heat, Portland cement

(2)	IS 8112	Specification for 43 grade ordinary Portland cement
(3)	IS 12269	Specification for 53 grade ordinary Portland cement
(4)	IS 383	Specification for Coarse and fine aggregates from natural sources for concrete
(5)	IS 456	Code of practice for plain and reinforced concrete
(6)	IS 460	Specification for test sieves (Part I, II & III)
	i)	Wire cloth test sieve
	ii)	Perforated plate test sieve
	ii)	Method of examination of test sieves
(7)	IS 515	Specification for natural and manufactured aggregates from natural sources for concrete.
(8)	IS 516	Method of test for strength of concrete
(9)	IS 875 (Part I, II & III)	Design loads for building structure.
(10)	IS 1199	Method of Sampling and analysis of concrete
(11)	IS 1791	Batch type concrete mixers.
(12)	IS 1893	Earthquake resistant design.
(13)	IS 2386	Method of test for aggregate for concrete (Part I, II & III)
	i)	Particle size and shape
	ii)	Estimation of deleterious materials and organic impurities
	iii)	Specific gravity, density, voids, absorption and bulking.
(14)	IS 2505	General requirements for concrete vibrators.
(15)	IS 2645	Specification for Integral cement water proofing compound.
(16)	IS 3025	Method of Sampling and test (Physical and Chemical for water)
(17)	IS 4326	Code of practice for earthquake resistant design and construction of building.
(18)	IS 4926	Specification for ready mixed concrete.
(19)	IS 7861	Code of practice for extreme weather concreting
	i)	Recommended practice for cold weather concreting
	ii)	Recommended practice for cold weather concreting
(20)	IS 9103	Specification for admixture for concrete
(21)	IS 12118	(Part I) Specification for two parts polysulphide based sealant: general requirements
(22)	SP 23	Hnadbook on concrete mix
(23)	SP 24	Explanatory handbook on Indian Standards code for plain and reinforced concrete (IS 456)
(24)	SP 27	Handbook of method of measurement of building works.

1.2 Quality Assurance

1.2.1 Concrete used on site shall comply to relevant parts of Standards, Codes of practices, technical specification given in particular or approved, designed mixes as prepared, approved and adopted for works to give designed strength, serviceability, long term durability etc.

1.2.2 Provide and monitor quality control over materials received from suppliers / manufacturers to ensure that materials comply with standard specified and are as approved.

1.2.3 Provide experienced supervision and work force to ensure that workmanship is of specified quality.

1.2.4 Work shall not be subjected to harmful, dangerous, damaging or deleterious exposures while it is in progress or on completion during

1.2.5 contract period.

Contractor to under take quality assurance by documenting.

- Test report for material used in producing concrete.
- Mix design details with laboratory test report, actual site trial mix

test and accepted modified design if any

- Pour cards with approval of the Incharge prior to placement
- Control charts
- Non conformance reports, changes, orders etc.

1.3

1.3.1 Submittals

Submit samples of all materials such as cement, sand, aggregate, admixtures, water etc to be incorporated into concrete along with test certificates from recognized laboratories for the Incharge's approval.

1.3.2 Samples

During construction, the materials shall be sampled and tested as often as directed by the Incharge to the contractor. Samples shall be taken and tested in accordance with latest revisions of Indian standard specifications and the cost thereof shall be borne by the Contractor.

1.3.3 Shop Drawings

Contractor shall prepare and submit method, mode of casting of slabs, beams with details of construction and expansion joint for approval of the

1.4.0 Incharge.

Examination of conditions

Contractor shall inspect and examine sub strata and confirm prior to start that.

- Substrate is acceptable and approved by Incharge
- Conditions are satisfactory
- Setting out/Layout is verified
- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0

2.1

MATERIALS

Cement

Cement shall be ordinary Portland Cement conforming to IS and shall be of grade 53/43 for structural use or as specified in drawing.

It shall be received in bags of 50 kg or loose in tankers and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In case cement has been stored for over 3 months or for any reasons the stored

2.2 cement shows signs of deterioration or contamination, it shall be tested

2.2.1 as per the direction of the Incharge prior to use in the works.

Coarse aggregate

Coarse aggregate shall be obtained from natural sources such as stone, gravel, etc., crushed or uncrushed or a combination thereof from approved quarries. Aggregate shall be hard, strong, dense, durable, clean and free from veins and adherent coatings. It shall be free from soft,

2.2.2 feeble, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall consist of coarse material, most of which is retained on 4.75 mm IS sieve.

Coarse aggregate shall not contain any harmful material such as iron, pyrites, coal, mica, shale or similar laminated material; neither shall it contain clay, alkali, soft fragments, sea shells, organic impurities, etc. in such quantities that adversely affects the strength and durability of the concrete. In addition to the above, in reinforced concrete the aggregate shall not contain any material which might attack the reinforcement. The

2.2.3 maximum quantities of deleterious materials in the coarse aggregate, when determined in accordance with IS 2386 Part I and Part II "Method of test for aggregates for concrete" shall not exceed the limits laid down in table 1 of IS 383.

Aggregate crushing value, impact value, abrasion value and soundness of aggregate shall respectively be in accordance with para 3.3, 3.4, 3.5 and 3.6 of IS 383.

2.2.4 Grading of coarse aggregate shall be in conformity with the requirements laid down in IS 383. See table 2 and table 3.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregates shall be well graded.

For heavily reinforced concrete the aggregate shall be subjected to tests in accordance with IS 2386 or and directed by the Incharge.

The maximum size of coarse aggregate should not be greater than one fourth of the minimum thickness of the member and it should be restricted to 5 mm less than the minimum clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement.

2.2.5

Source of aggregate shall be from an approved Government location. It shall be tested prior to the approval of the Incharge from an approved testing laboratory. In case available aggregates do not meet certain requirements of IS 383 or any other specification, required processing shall be carried out by the contractor at his cost. No extra cost towards these processes, treatment or combination of both shall be paid. It shall be the duty of the contractor to make sure that aggregate material received by him is from Government approved quarries and with fully paid royalties, taxes, duties, etc. as may be in force from time to time for respective locations.

2.2.6 Coarse aggregate shall have a minimum specific gravity of 2.6. (Saturated surface dry basis). Aggregate below this specific gravity shall

2.2.7 not be used without the special permission of the Incharge.

Once a specific source of supply of coarse aggregate is approved, the source shall not be changed without the prior approval of the Incharge.

Fine aggregate

Natural sand deposited by stream or glacial agencies as a result of disintegration of rock shall be used as fine aggregate. Fine aggregate

shall pass through 4.75mm sieve in total. Crushed sand may be added to natural sand in approved proportions to achieve required grading. The fine aggregate (coarse sand FM above 2.25 & Fine sand F M more than 1.25) shall conform to following standards.

2.2.8 (i) For plain and reinforced concrete — IS 383 Specification for coarse and fine aggregates from natural sources for concrete.

(ii) Mortar and grout for — IS 2116 Specification for sand for masonry mortars.

Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious material is within the permissible limits laid down.

2.2.9 Grading of fine aggregate shall conform to IS and shall fall within limits of one of the four zones given in table 4 of IS 383.

2.3.0 Due allowance for bulking due to damp and moist sand shall be made while preparing the mixes based on volume measurements. It shall be determined as per IS 2386 Part III Appendix A.

2.4 Water

2.4.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalies, acids, salts so as not to weaken mortar, or concrete or cause efflorescence or attack the steel in RCC while curing. It shall be free of elements, which significantly affects the hydration reaction or otherwise interferes with hardening of concrete during curing or those elements which produce objectionable stains or deposits. Potable water is generally satisfactory but it shall be

2.4.2 tested prior to use in the works.

Water tested shall be in accordance with IS 3025. Maximum permissible

2.4.3 limits of deleterious materials in water as given in IS 456.

Suitability of water shall be ascertained by the compressive strength and initial setting time test as specified under:

a) Average 28 days compressive strength of atleast three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of

three similar concrete cubes prepared with distilled water. Preparation and testing to be in accordance with IS 516. b) The initial setting time of test blocks made with proposed cement and water to be used shall not be less than 30 minutes and shall not differ by ± 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. Preparation and testing of block shall be in accordance with IS 4031.

2.4.4

2.4.5

2.5 The PH value of water shall not be less than 6 and more than 9.

2.5.1 Water shall be tested and approved in writing by the Incharge prior to use in the works,

Admixture

These are substances other than cement, aggregate and water and shall be permitted to be used to modify the properties of concrete for single, or a combination of purposes. This shall be used only on the written approval for specific purpose and at the cost of the contractor. Good concrete shall be achieved without the aid of any admixtures.

2.5.2

Admixtures shall be free from chlorides and sulphates which might affect concrete or any other material which may cause problems to the concrete in the due course of time. Also it shall have no effect on the reinforcement in case of Reinforced Cement Concrete.

2.5.3

Admixtures generally in use are classified as under:

a) Accelerators
b) Retarders
c) Workability agents
d) Water repelling agents
e) Air-entraining agents
f) Gas-forming agents
g) Corrosion inhibitor additive

These are manufactured and sold by various companies under brand names. The contractor proposing to use any one of them shall submit to the Incharge technical literature with its chemical composition, purpose of use and method recommended by the manufacturer and what he proposes to follow at site for strict control.

2.5.4

The contractor's proposal shall accompany the followings with his request to use admixture.

a) The trade name of the admixture, its source and the manufacturer's recommended method of use.

b) Typical dosage rates and the possible detrimental effects of under and over-dosage.

c) Whether the admixture contains chloride in any free form or any other chemical present as an active ingredient which is a likely cause of corrosion of reinforcement or deterioration of concrete.

d) The average expected air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

2.6 Miscellaneous

2.6.1 Integral cement water proofing compound specified for specific use shall conform to IS 2645.

2.6.2

2.6.3 Bituminous felts for waterproofing and damp proofing course shall conform to IS 1322.

2.6.4 Bituminous compounds for water proofing purposes shall conform to IS 1580. Expansion joint filler

2.6.5 Bituminous impregnated premoulded preformed expansion joint filler board conforming to IS 1838 part (I) specification for preformed filler boards shall be of approved quality and thickness at designated locations.

Polysulphide sealants

1 Expansion, construction or other joints shall be sealed with approved quality polysulphide sealants.

2 One part gun grade polysulphide-based joint sealants shall conform to IS 11433 (Part I). It shall be used with the approval of the Incharge and as per the manufacturer's instructions. Correct primer shall be used at the specified location.

3 Two part polysulphide based sealant gun grade or pouring grade shall conform to IS 12118 (part I). Pouring grade shall be used in horizontal joints. Gun grade shall be used in vertical, inclined and horizontal joints. Specified primer shall be applied prior to the use of sealant. Use of sealant shall be as per instructions of the approved manufacturer.

4 Sealant shall be cured at ambient temperature and humidity when applied as per the approved manufacturer's instruction and received in suitable packs. Each package shall indicate

Manufacturer's name and trade mark
Weight of the components
Instructions for storage
Type and grade of sealants
Date of manufacture and expiry
Instructions for use

2.6.6 Water bar

PVC or rubber water bar of type, quality and width shall be used as approved by the Incharge. Water bar shall be continuous and fixed at the indicated locations. Water bar should be welded or Joined with the

approved method. All angles and corners shall be purpose-made and
2.7 shall be joined with the approved method.

2.7.1 Delivery and Storage

It shall be received in bags of 50 kgs and each batch shall be accompanied with a test certificate of the factory. Reject damp or torn bags.

Cement shall be stored in dry and water proof shed so as to prevent deterioration due to moisture, dampness. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 10 bags permitted. Stacks shall be so arranged that the first batches are used first, (FIFO) and that they permit easy access for inspection and handling.

2.7.2 Loose cement received shall be stored in silo's. Silo's shall be equipped to receive cement by pump and manually. Silo's shall be water tight and damp proof to keep cement fresh.

Coarse Aggregates and Fine Aggregates

Aggregate shall be stored in such a way that it does not get mixed with
2.7.3 mud, grass, vegetables and other foreign matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the Incharge.

2.7.4 Water

Water storage tanks shall be such as to prevent any deleterious materials getting mixed with it.

3.0 Covered storages

Considering the atmospheric/ weather conditions at site storages, covering shall be arranged to take care of temperature controls at site.

CONCRETE

Concrete is prepared by mixing graded aggregate of stone or along with cement, in a specified proportion. Mixing shall be done by a mechanical mixer. Manual hand mixing shall be permitted in specific cases with the
3.1 written permission of the Incharge on account of small quantity or location or any other reason acceptable to the Incharge.

Cement concrete

This shall be classified as plain cement concrete or reinforced cement concrete. Plain cement concrete shall be In leveling course under foundations, floors, copings. etc. and shall include form work as part of the work.

3.1.1 Reinforced cement concrete shall be at all locations and comprises form work. reinforcement and concrete. Payment of reinforced cement
3.1.2 concrete may be composite or item wise as specified in the BOQ. In PCC, payment for form work shall not be made.

Concrete shall be classified by its compressive strength at the 28th day. The concrete grades shall be as designated in table 2 of IS 456 "Grade of

concrete".

Design.mix

BOQ shall specify various types of concrete aimed to be used in works. It shall be the responsibility of the contractor to carry out design mixes and approval of the same shall be obtained from the Incharge atleast 35 days in advance from the actual pouring of concrete at site in the permanent works.

1. Mix design of concrete shall be done as per IS 10262 & SP 23,24.

Following basic points shall be finalised.

- Characteristic compressive strength and targeted compressive strength required at design stage.
- Standard deviation factor based on site actual execution conditions.
- Minimum cement specified in BOQ or as per IS for strength and durability for location where concrete is to be used.
- Water cement ratio permitted by IS.
- Workability to be achieved for better workmanship and good quality concrete
- Admixtures to be used if any
- Aggregates being used are tested to IS383. Include for Alkali reactivity, chloride and sulphate contents independently and combination of cement and water.
- Water being used is tested.

Further the contractor shall ensure that designed mix meet minimum cement contents as specified in BOQ/drawings and proposed revision to IS 456 along with maximum water cement ratio, to different exposure condition from durability point of view. In addition contractor shall ensure

a) Alkali – reactivity

Aggregates containing material susceptible to attack by alkali's (Na_2O and K_2O) originating from cement or other sources and producing expansive reaction shall not be used.

The aggregates source shall be initially tested for alkali reactivity prior to being used in design mix.

b) Sulphate and chlorides in concrete

Harmful salts coming from the concrete materials such as cement, aggregate, water and admixture, as well as by diffusion from environments shall be limited to following weight of cement.

- Total chlorides (as Cl) -0.15%
- Total soluble sulphate (as 803) - 4 %

3.1.3.1 Compressive strength

For expected strength of cubes tested on the 28th day, the design mix at preliminary test and work site shall be as per IS 456 - 2000.

3.1.3.2 Water cement ratio

The water-cement ratio shall be between 0.42 to 0.55. Additional water may be permitted only at the discretion of the Structural Engineer. The slump shall depend upon the location and type of work. Higher slump

3.1.4 with use of plasticizers shall be permitted.

3.1.4.1 Trial mixes

The contractor shall submit, at least 5 weeks in advance, to the Incharge the mix design that he proposes to use at site. The mix design in addition to points in 3.1.2 shall also give basic details (when tested according to IS 1199 and IS 2386-Part III 1963), as per followings

a) Slump/Workability
b) Bleeding
c) Compacting factor
d) Vee-Bee time
e) Cement required for one cubic meter of concrete
f) Wet and dry density
g) Air contents if applicable

3.1.4.2

On receipt of this, the Incharge may immediately order to carry out work site test before the final approval. This shall be done with mixer and materials actually being used at site.

This shall give the contractor additional chance to check for himself actual workability and make sure that the mix proposed by him will be fully satisfactory with regards to slump, segregation, bleeding, water-cement ratio and workability.

6 cubes shall be taken from each of the 3 batches to test the mix. Cubes shall be cast, stored, cured, transported and tested to IS 516. The test may be carried out at site or laboratory as approved by the Incharge.

Trial mixes shall be approved provided that average strength of 3

3.1.4.3 consecutive cubes is not less than that specified and that one out of three may give a value. less than specified but limited to a maximum of 90% of the specified strength.

In case the trial mix falls below the above criterion, the Incharge shall order fresh trial mixes to be made as before, until the desired strength is arrived at.

3.1.4.4 This design mix and trial mix hold good so long as the materials continue to be of the same quality and from the same sources. For any change, the Incharge may order fresh design mix and trial mixes to be carried out before the same Is used at site.

3.1.5 Mixing of concrete

3.1.5.1 Machinery and equipments.

a) Batching

Batching shall be done by weigh batchers conforming to IS 2722. A platform scale of capacity 300kg with fraction upto

100gms shall be at site.

For water supply to mixture through metering system shall be organised.

Design mix converted to volumetric may be permitted by Incharge. Accordingly suitable size of boxes equivalent to 1 bag of 50kg cement shall be prepared by the contractor.

b) Mixer

Mixers used shall conform to IS. Type Capacity shall be as per size, extent and nature of work.

c) Transportation

Wheel borrows, cranes, mini dumpers, truck, agitators, belt conveyors, pumps with piping etc. as per requirement depending upon location, size extent and nature of work shall be deployed by the contractor with prior approval of the Incharge.

d) Vibrators

Internal and external vibrators working on electricity, Pneumatic or petrol shall be approved by the Incharge. Vibrators shall conform to IS.

e) All machineries and equipments shall be maintained regularly. Periodic calibration of all machines shall be done and

3.1.5.2 records maintained in a register. As and when requested by the Incharge same shall be forwarded for his inspection.

At the start of mixing, mixer shall be rinsed/coated by loading with cement, sand, water of the same proportion of batch to be used. Loading the mixer/charging the mixer shall be done mechanically and care to be taken that all material is fully loaded.

The mixer shall be run for a minimum period of 2 minutes after all

3.1.5.3 materials are loaded in full quantity. The concrete produced shall be uniform in colour and consistency. Unless agreed by Incharge the first batch of concrete from mixer shall contain two-third of normal quantity of coarse aggregate.

Transportation

Concrete shall be transported to place of pour as far as possible in most efficiently, conveniently and without loss of concrete characteristic. Method of transportation shall depend upon the location, size and nature of work. Concrete should be placed within 1.5 hours of production i.e. prior to initial set.

Use of admixtures such as air entraining agent, retarders etc. shall be adopted and incorporated into design mix stage.

Concrete shall be kept in agitating state when ambient temperatures are

high. This shall increase placing time to 1 % hrs after water is added.

Points to be taken care are

Method adopted do not permit segregation

Containers used are leak proof

Containers are well covered during rains, heavy winds

Concrete does not get contaminated by oil, dirt etc.

3.1.5.4 Placing

The placing temperature of concrete shall not be more than 34° C. If it is more, the Incharge may order addition of ice or chilled water to the concrete. Also the contractor shall take the following precautions :

a) Mixers and weigh batchers shall be painted with white colour

b) Aggregate storing bins shall not be exposed to the Sun

c) Water shall be sprinkled on aggregates well before concreting to keep the temperature low.

d) Use chilled water for mixing or add flake ice as a proportion of the mixing water.

e) Place concrete at night.

f) Ready mix concrete (RMC)

3.1.5.5 a) Concrete

Ready mix concrete as approved only shall be used. It shall comply all requirements of concrete. Batching plant, mixture, truck mixture, pump etc shall conform to relevant Indian standard. Daily returns shall be provided showing total volume of each class of concrete received.

b) Pumping of concrete

Stationery or mobile pumps as per requirements shall be deployed. Concrete shall be continuous to avoid any blockage within pump. Concrete mix shall be with slump as desired by pump manufacturer and most desirable at site to pump operator / supervisor.

Required piping, bends, clamps, chutes etc. shall be well organised and placed in position prior to start so continuous concrete with minor changes will keep concrete flowing at predetermined location in approved manner.

Mix design adopted shall be approved by Incharge and shall conform all test as detailed in specification.

Pump concrete shall flow quite fast and is placed with larger impact on formwork. Hence special precautions at design stage of formwork shall be taken and staging /scaffolds should be well restrained in all directions to withstand thrust.

3.1.6 Pumping shall be done with due care and safety. Recommendation of pump suppliers shall be followed strictly.

Shrinkage cracks

3.1.7 Concreting shall be avoided in very warm weather. If necessary, it shall be covered with damped hessian within 2 hours of placing of concrete.

To achieve good results the concrete shall be immediately covered with a plastic sheet and not allowed any direct wind contact. This shall eliminate shrinkage cracks.

Laying of concrete

a) Concreting shall commence only after form work is approved, reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Incharge.

b) Form work should be clean, free from sawdust, pieces of wood or any other foreign material. It should have been treated by form releasing agent prior to the laying of reinforcement and concrete. Prior to placing concrete against old concrete, masonry, rock all loose materials shall be removed and surfaces washed down. Concrete shall be worked around ties and bond and in open joints.

c) Concrete shall be as gently deposited as is practically possible, in its final position to avoid re-handling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footings, it may be done with the help of a chute. Columns and walls shall be so adjusted in form work so that maximum depth is 1.5 metre unless consented to by the Incharge. Concrete from wheel barrows shall not be dumped away from the face of concrete already in place. It shall be dumped into the face of concrete already in place. In excavations prevent contamination of earth and concrete without disturbing unsupported sides of excavation. Concrete shall not be placed in water except where specified.

d) Concrete onto a sloping surface shall be discharged by providing a chute with a baffle and a drop at its end so that the concrete remains on the slope.

e) Columns and walls shall be concreted in one operation to their full height to avoid any horizontal construction joint as far as possible.

f) All slabs, beams, wooden planks, and cat-walks shall be provided clear of reinforcement.

g) Concrete shall be placed in position within 30 minutes from the time it is produced. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be

3.1.8 permitted only on the written approval of the Incharge.

h) Placing in each section shall be a continuous between construction joints. The contractor shall make provision for standby equipment. In case of delay or break down stop

ends are to be provided or concrete placed to be removed as per direction of the Incharge.

i) Placing shall not take in open during storms or rains, strong winds. Contractor to organise and provide required protection.

Compaction of concrete

3.1.9 Concrete shall be thoroughly compacted as depositing shall proceed by means of able vibrators. The vibrators shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during the whole period occupied by placing of concrete. Care shall be taken not to over- vibrate the concrete. While withdrawing needles no holes should be visible in concreting. Compaction shall be completed before the initial setting time. Concrete already set shall not be disturbed by successive vibrations.

It shall be ensured that the needle vibrators are not applied on reinforcement which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use, the standby petrol vibrator must always be available at the concreting point.

Construction joints

In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the Incharge. Such joints shall be kept to a minimum. The joints shall be at places where shear force is nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

3.1.10 Before commencement of concrete, adjacent concrete stopper and surfaces shall be chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

3.1.11 True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber.

Prepared joint shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

Expansion joints

Expansion joints shall be formed and located as detailed in the drawing. Insert sealant to completely fill the joint and finish neat and smooth.

Curing

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Incharge. As said above in clause 3.1.8, after concrete has begun to harden i.e. about 1 to 2 hours after laying,. it shall be protected from quick drying with moist or damped hessian cloth or any other material approved by the Incharge. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damp hessian cloth for a period of 7 days to keep it moist.

For the next 7 days the surface shall be kept wet all the time by sprinkling water continuously.

For membrane curing, details as listed in 12.5 of SP 24 shall be

3.1.12 followed.

Finishing

Concrete shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted but the Incharge shall be consulted prior to start of concreting and his decision in this regard shall be final.

a) Roof slab shall be trowelled even and smooth with a wooden float.

b) The surface that will receive plaster shall be roughened immediately.

c) Surfaces that will be in contact with any masonry work shall be roughened immediately,

d) The surface that will receive mosaic floor or IPS or any other type of tiled work shall be roughened while it is green. Every care shall be taken not to disturb the freshly laid concrete.

3.1.13 e) For dust proof (or hardened) finish, clean the concrete surface of

3.1.13.1 oil and contamination and apply approved dust proof hardener as per manufacturers instructions.

Inspection and corrective measures

On removal of form work, the surface shall be examined by the Incharge. Till such time, no remedial measures shall be carried out by the contractor. All patching, rectification or chipping shall be done only on the Incharge's instructions. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Incharge in this regard shall be final and binding on all parties.

3.1.13.2 Sagged, bulged, patched, honeycombed work shall stand to be rejected for surfaces that are exposed, or require fair face finish or decorative

textured finish. The Incharge may permit any work found structurally safe and areas of unexposed faces, for repairing. As directed by the Incharge these works shall be retained and the cost of repair shall be at the contractor's account.

Cracks observed shall be brought to the notice of the Incharge who shall examine them. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to (lie Structural Engineer and the following procedure shall be followed :-

a) Cracks not developing further and in the opinion of Structural Engineer not detrimental to the strength of the construction shall be grouted with non-shrinking cement slurry or as directed by the Incharge.

b) Cracks developing further and, in the opinion of the Structural Engineer, detrimental to the strength of construction, shall be tested as per the relevant Indian standard.

c) Based on results of the test, the Incharge in consultation with the Structural Engineer shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequential works thereto.

d) Cost of the above shall be borne by the contractor if the failure was on his part. In case it is due to design faults, it shall be borne by the employer.

e) The decision of the Incharge in this matter shall be final and binding on all parties. This decision shall not be open for arbitration.

3.1.14 Testing

3.1.14.1 Quantum of cubes and testing

The minimum frequency of cube casting shall be as follows. Each sample shall consist of 6 cubes.

Concrete quantity	Number of Samples.
Upto 5 cu m in a day	: 1
5 cu m to 15 cu m	: 2
15 cu m to 30 cu m	: 3
30 cu m to 50 cu m	: 4
More than 50 cu m	: 4 + one additional per each 50 cum or part thereof

3.1.14.2 Three cubes shall be tested on the 7th day and other three cubes on the 28th day.

Field Tests

It is the responsibility of the contractor to prepare and get the cubes tested and to provide all the material, labour, moulds, equipment, casting and curing facility, charges for testing, etc.

Further, the contractor shall have to provide and maintain all the equipment and staff at the site throughout to carry out the following tests in a small laboratory or get these tests from approved laboratories without extra cost to the contract.

a) Grading of coarse and fine aggregates

3.1.14.3 b) Silt content of sand

c) Moisture content of coarse and fine aggregates

d) Slump test of concrete

e) Concrete cube test

The contractor shall maintain full records of all above tests in a register. The format of records shall be prepared in consultation with the Incharge

3.2 and either he or his representative shall have full access to the

3.2.1 contractor's laboratory.

The contractor shall include charges for the above work in his rates and no extra whatsoever shall be admissible on this account of designing,

3.2.2 testing, maintaining laboratory, etc.

Concreting under special conditions

Work in extreme weather conditions

During hot or cold weather the concreting should be done as per the procedure set out in IS 7861 Part I or IS 7861 Part II or as directed by the Incharge

Underwater concreting

The procedure set out under 13.2 of IS 456 shall be followed or as directed by the Incharge

3.2.3 Concreting in sea water

The procedure set out under 13.3 of IS 456 shall be followed or as directed by the Incharge.

3.2.4 Concreting in aggressive soils and water

Guidelines laid down in 13.4 of IS 456 shall be followed together with the Instructions of the Incharge.

3.3.0 Precast concrete

3.3.1 Precast concrete can be plain or reinforced. It shall meet all requirements and specifications of concrete as stated hereof. Precast concrete shall be done for cellular roof units, drainage or specially designed for specific use taking Into consideration achievements In flexibility, speed and economy

3.3.2 in construction.

Precast concrete units shall be cast in a suitable mould so as to make sure that they are,

a) Easy to lift

b) Easy to transport

c) Excellently finished

d) Handy to erect and Join at site

Units shall be sound and free from cracks or any other defects that would interfere with the proper placing of units or the strength or performance

3.3.3 of units or the structure.

Precast units shall be lifted and handled with proper tools from points designated to avoid any cracking or developing of any undue stresses . If required, necessary tools and tackles shall be fabricated by the contractor. Precast units shall be removed from mould within 24 hours or the time allowed by the designer or as approved by the Incharge.

All units that are. in the opinion of the Incharge, cracked and unsafe, shall be removed forthwith and no arbitration on this account shall be applicable.

Units shall be stored and stacked in the precasting yard in a proper manner. The date of casting shall be noted therein and wet curing for 15 days shall be done without fail. The yard shall have a duly dressed ground and sufficient supports at the required intervals to receive precast

3.4.0 units.

Units shall be erected only after 28 days of casting and after the cubes of those days have given the strength specified.

Tolerances in units shall not be more than ±3 mm as approved by the Incharge taking into consideration the purpose and location of use.

Plum Concrete

Stone plums shall be used only when specified. Size of stone plums may be from 150 to 300mm.

Plums shall be hard, double clean and free from soft or loose pieces or deleterious material and should not have sharp corners.

Generally first layer of concrete of specified mix shall be of thickness 2.5 time thickness of maximum size of plums to be used. Plums shall be laid when concrete becomes stiff but top portion is still green. No plums shall be used for concrete laid under water. The thickness of next and successive layers shall be 2 times that of largest plums.

3.5.0 Measurements

1. All works shall be measured in the decimal system.

a) Dimensions shall be measured to the nearest 0.01 metre except for thickness of slab which shall be measured to the nearest 0.005 metre.

b) Areas shall be worked out to the nearest 0.01 sq m

c) Cubic contents shall be worked out to the nearest 0.01 cum

2. All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.

3. Cement concrete work shall be classified as under:

   a) Concrete cast in-situ : Plain and reinforced

   b) Precast concrete : Plain and reinforced

   c) Prestressed concrete : Cast in-situ or pre-cast

4. All concrete, except as hereinafter provided, shall be measured in cubic metres.

5. The price of concrete shall include ingredient material,

mixing, transporting, hoisting to any height and lowering to any depth, pouring or laying, consolidating, leaving pockets, holes, and protecting them till the next operation or completion of work, hacking the surface to provide key for further work including cleaning, wetting surface, etc. and preparing construction joints as described in clause 3.1.9. of this section.

6. Concrete processed in a special manner for any specific purpose, such as cooled, heated, water-proofed, acid-proofed, heat-resistant shall be measured separately and as per provision in BOQ.

7. Admixtures shall be used if necessary at the request of the contractor for workability and the price for that shall be deemed to be included in the contractor's quoted price of concrete.

8. No deductions shall be made for:

(a) Ends of dissimilar materials (for example beams, posts, girders, purlins, corbels and steps) upto 500 sq cm in section.

(b) Opening upto 0.1 sq m,

(c) Volume occupied by reinforcement.

(d) Volume occupied by drainage, water pipes, conduits, etc. not exceeding 100 sq cm, each in cross sectional area.

(e) Small voids each not exceeding 40 sq cm in section.

(f) Small moulds, drip moulds, chamfers, splays, rounded or covered angles, beads, grooves and rebates upto 10 cm in depth and width.

9. Expansion joints shall be measured in running metre or sq m as the case may be. Price shall include required shuttering, special treatment if any, filler and finishing material as detailed in drawing or the BOQ.

10. Water proofing of concrete shall be measured separately as an extra over ordinary concrete stating the quantity of water proofing material in litres or kilograms.

11. Surface treatment shall be measured in square metres stating number of coats and proportioning of water proofing liquid to water.

12. Grouting of holding-down bolts and providing temporary boxing or wedges to form holes shall be enumerated. The mix shall be specified. The price shall include required shuttering, grouting, etc.

13. To keep surface dry while concreting, dewatering due to rains and seepage shall be included in the price of concrete.

SECTION – II B

REINFORCEMENT WORK

1.0 GENERAL

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/ conflict noticed shall be directed to the Incharge for his direction/approval. However as a general rule more stringent specification shall take precedence.

1.	IS 226	Specification for steel standard quality.
2.	IS 228	Methods for chemical analysis of steels.
3.	IS 280	Specification for mild steel wire for general engineering purpose.
4.	IS 432	Specification for mild steel and medium tensile steel burn and hard drawn steel wires for concrete requirement.
	Part 1	Mild steel and Medium tensile steel bars.
	Part 2	Hard drawn steel wire.
5.	IS 456	Code of practice for construction and design of reinforced concrete.
6.	IS 816	Code of practice for use of metal are welding for general construction in mild steel.
7.	IS 961	Specification for structural steel: high tensile steel bars
8.	IS 1566	Hard drawn steel wire fabric for concrete reinforcement.
9.	IS 1599	Method of Bend test
10.	IS 1642	General requirements for fire protection.
11.	IS 1785	Cold drawn stress relieved wire (part I)
12.	IS 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
13.	IS 2751	Code of practice for welding of MS bars.
14.	IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
15.	IS 2751	Code of practice for welding of MS Bars.
16.	IS 3696	Safety Code of scaffolds and ladders:
	Part I	Scaffolds
	Part 2	Ladders
17.	IS 4014	Code of practice for steel (Part 1 & 2) tubular scaffolding
18.	IS 4082	Recommendation on stacking and storage of construction materials at site.
19.	IS 5525	Recommendation for detailing of reinforcement in RCC

work.

20.	IS 9417	Recommendation for welding cold worked steel bars for reinforced concrete construction.
21.	IS 10790	Method of sampling of steel for priestesses and reinforced concrete.

1.2 Quality Assurance

1.2.1 The Contractor shall procure and provide reinforcing steel bars conforming to IS specified and shall comply with all physical, chemical and mechanical test. Each type shall be from same

1.2.2 manufacturer.

Steel manufacturers shall conform steel produced conforms IS requirements for reinforced cement concrete works.

Steel shall not react chemically with ingredient of reinforced cement

1.2.3 concrete which are harmful to strength, durability of reinforced

1.2.4 cement concrete.

Unit weights and diameter of rolled steel bars shall conform to IS.

1.2.5 Provide supervision and work force with minimum 5 (five) years experience to ensure workmanship of specified quality.

Contractor to undertake documenting of

- Test reports for steel brought at site for each lot
  - a) Chemical composition from factory
  - b) Mechanical
  - c) Physical

1.2.6 • Barbending schedule for cutting and bending

1.3 • Record of laps and anchors / development length

1.3.1 Work shall not be subjected to harmful, dangerous and damaging exposures.

1.3.2 Submittals

Submit for approval of the Incharge all details of Material / Product which conforms the specification laid down in documents.

Submittals shall include

- Product data sheet
- Manufacturers certificates

1.3.3 • Test report of laboratories

- Alternative product if any with tabulation for conformation that alternatives proposed meets / exceeds specification.

Samples

Samples of type materials to be used. Further during construction samples shall be taken and tested by the Contractor as per specification and as directed / instructed by the Incharge. The cost of samples and test shall be borne by the Contractor within quoted prices.

1.3.4 Shop drawings

Contractor shall prepare and submit bar bending schedule based on structural detailed drawing prior to fabrication for approval of the Incharge.

1.4 Examination of Conditions

Contractor shall inspect and examine sub strata and confirm prior to start that.

- Substrate is acceptable and approved by Incharge
- Conditions are satisfactory
- Setting out/Layout is verified
- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0 MATERIAL

2.1.0 Reinforcing Bars

2.1.1 Reinforcement bars used in construction shall be mild steel or medium tensile steel round bars and high strength deformed bars. Steel shall be fresh and new. It shall be free of defects and free of rust, oil, paints, grease, loose mill scale or any other deleterious material undesirable for RCC or prevent adhesion of concrete with

2.1.2 reinforcement.

M S Plain

Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part I. Steel received shall conform to the following IS with regard to manufacturing and chemical composition.

1. M.S. bar Grade I Steel designation Fe 410-S of IS 226

2.1.3 2. M.S. bar Grade II Steel designation Fe 410-0 of IS 1977

3. Medium Tensile Steel designation Fe 540 Steel bars W-HT IS 961

Nominal sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS

2.1.4 1608, read in conjunction with IS 226. For reference of minimum requirements, properties are tabulated in IS 432 Table 1 "Mechanical properties of bars mild steel & tensile steel bars".

2.1.5 Tor / TMT (Thermo-Mechanically-Treated) Steel

High-strength deformed bars for use as reinforcement in concrete

2.1.6 shall be of grade Fe 415, Fe 500 and Fe 550 conforming to IS 1786.

Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228.

2.1.7 Welding of cold work steel bars in reinforcement shall be permitted as per IS 2751 and 9417. (Recommendation for welding cold worked steel bars for RCC).

Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerances

specified therein.

2.1.8 Physical properties

a) It shall satisfy IS 1599 test for bend and rebend test in conjunction with IS 226.

b) Bond requirements shall be deemed to have been satisfied if it meets clause 4.Oof IS 1786.

c) Tensile, proof stress and percent elongation shall be as per table 3 of IS 1786.

2.1.9 Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387.

In case bars are without ISI certification mark, the manufacturer shall give a certificate stating process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the batch production/

2.1.10 cast to which it applies. Corresponding number or identification mark should be found on the material.

All reinforcement material shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any

2.1.11 foreign deleterious material present on the surface. Cleaning shall be done to the satisfaction of the Incharge.

Each batch brought at site shall be tested prior to use for respective specification / physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. All rejected material shall be removed from site by the contractor within 3 days of rejection. If the same is not

2.2.0 done, the Incharge shall impose a penalty of Rs.500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

Cover block

Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Designed purpose made PVC cover spacers shall be used in the Works. Concrete cover spacers

2.3.0 may be permitted by the Incharge. Such concrete spacers shall be cast from concrete and not cement-mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.

Binding Wire

2.4.0 Binding wire shall be 16 or 18 gauge annealed wire conforming to IS 280. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with

reinforcement.

Mechanical Splices

Mechanical Splices fabricated out of steel pipes, sheets etc. capable of withstanding bending and compression stress equal to 1.25 times of those specified for reinforcing bars shall be used. Supplier of splices should submit details about quality of materials, mechanical test results and method of splicing. Required hydraulic press and clipping equipments shall be arranged by the Contractor.

Sa Samples pieces shall be prepared at site and shall be tested for torsion.

Sample pieces results should give value of about 1.5 times than required for reinforcing bars.

2.5.0 Delivery and Storage

Reinforcing steel bars each batch should accompany manufacturers certificate. Reinforcement bars received at site shall be loaded and unloaded at site and stored with care such that it does not get bent or damaged. Steel received shall be as far as possible in straight length of 12 M. Steel shall be weighed in presence of representative of the contractor prior to delivery being received by him. Empty and loaded truck loads shall indicate correct quantity.

Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by tarpaulins or plastic to avoid excessive corrosion and other contamination. Each dia of bars shall be stacked

3.0 separately. Bars without "ISI' / Tor marking shall not be brought to site.

3.1 **SCOPE OF WORK**

The contractor shall be responsible for

Material Procurement

a) The contractor will submit the Schedule of Procurement of steel in consultation with Incharge as specified and conforming to specifications detailed in drawings and bills of quantities.

The steel is free supply by the client to be delivered to site as per approved indent of the contractor to agreed schedule. However further all balance work to complete the reinforcement bar item shall be same as materials are supplied by the Client.

b) Receive steel and stack with covering on firm platform free of contamination.

c) Collect samples of each type for every batch received and test as per IS for

- Unit weight per running meter

- Cross section area
- Bend / Rebend Test
- Ultimate tensile strength

3.2
- Yield stress
- Elongation

d) Procure binding wire, cover blocks splices etc.

Prepare bar bending / cutting schedule detailing schedule covering as under and obtain approval of Incharge.

- Cutting lengths

3.3
- Laps

3.4
- Rings for various locations and items
- Chairs

3.5 Transport, cut, bend and shift to site reinforcing bars.

Place in position and tie as detailed in drawing reinforcement with specified cover

Provide attendance to keep reinforcement in position during concreting.

3.6 Disposal of surplus reinforcement steel as per approval of the Incharge.

3.7 Providing required tools, plants, equipments such as

- Material cutting and bending tools
- Bending platform Bar cutting machine
- Bar bending machine
- Hydraulic clipping machines

3.8 Unit weights payable per metre shall be as follows-

1. 6mm : 0.22 kg/Rmt
2. 8 mm : 0.40 kg/Rmt
3. 10 mm: 0.62 kg/Rmt
4. 12 mm: 0.89 kg/Rmt
5. 16 mm: 1.58 kg/Rmt
6. 18 mm : 2.00 kg/Rmt
7. 20 mm : 2.47 kg/Rmt
8. 22 mm : 2.98 kg/Rmt
9. 25 mm : 3.85 kg/Rmt
10. 28 mm : 4.83 kg/Rmt
11. 32 mm : 6.31 kg/Rmt
12. 36 mm : 7.99 kg/Rmt
13. 40 mm : 9.85 kg/Rmt

4.0 WORKMANSHIP

4.1 Fabrication of reinforcement

Reinforcement shall be fabricated as per the drawing and approved bar bending schedule. Bending shall be done mechanically or with hand but to the correct radius, with proper tools and platform and shall conform to IS 2502. Bending of material shall be cold bending

only. Material shall be inspected for visible defects such as cracks, brittle, excessive rust, loose mill scale, etc. Cracked ends of bars shall not be used in Works. Also the bars should be free from any deleterious material and hence the best practice shall be to hose down reinforcement just prior to concreting.

It is important that bending, straightening, cutting, etc. shall be carried out in a manner not injurious to the material and the safety of the persons working should be ensured.

4.2 Anchoring

Anchoring of bars and stirrup shall be provided exactly as detailed in the structural drawing or as directed by the Incharge.

4.3 Lapping of bar

Laps shall be strictly as per the drawing or as directed by the Incharge. For general guidance, the following principles shall be followed as given in IS 456.

a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.

b) Not more than half of the total bars shall be spliced at a section.

c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and/or using spirals or closely spaced stirrups around the length of the splice.

d) Lap splices shall not be used for bars larger than 36 mm diameter: For larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.

e) Lap length including anchorage value of hooks in flexural tension shall be Ld (as defined in 25.2,1 of IS 456) or 50 dia whichever is greater.

f) When splicing of welded wire fabric is to be carried out, lap

4.4 splices of wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.

Spacing of bars

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the Incharge.

a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following:

1. The diameter of the bar, if the diameters are equal.
2. The diameter of larger bar, if the diameters are unequal,

and

3. 5 mm more than the nominal maximum size of coarse aggregate (By using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome).

b) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-thirds of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.

c) Where there are two or more rows of bars, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm, two-thirds the nominal maximum size of the aggregate or the maxim size of bar, whichever is more.

4.5 Cover to reinforcement

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the Incharge. The following guidelines are to be observed in the absence of the above.

a) At each end of the reinforcing bar, not less than 25 mm, nor less than

twice the diameter of such bar;

b) For a longitudinal bar in a column, not less than 40 mm, nor less than the diameter of such bar. In the case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.

c) For longitudinal reinforcing bar in beam, not less than 25 mm, nor less than the diameter of such bar.

d) For tensile, compressive, shear or other reinforcement in slab, not less than 15 mm, nor less than the diameter of such bar; and

e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.

f) Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals, saline atmosphere, etc. and the cover shall be 50 mm or more as directed by the Incharge.

g) For concrete members totally immersed in sea water, the cover shall be 40 mm more than specified above (a) to (f).

This shall be 50 mm more for periodical immersion in seawater.

h h) Concrete cover should not exceed 75 mm in any case.Cover to reinforcement shall be as specified in the drawing or as directed

4.6 by the Incharge.

Details given in sub para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

Welded joints or mechanical connections

A) Welded joints or mechanical connections in reinforcement may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of the connected bars. Welding of reinforcement shall be done in accordance with IS recommendation. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that, at any one section, not more than 33 percent of the rods are welded.

B) Welding rods used shall conform to IS 814 : covered electrodes for metal arc welding of structural steel. Work shall be carried out by a competent welder. Samples from work site shall be taken at regular intervals and tested. Frequency and number of samples shall be as directed by the Incharge.

4.7 Fixing in position

4.7.1 Correctly cut and bent bars shall be accurately placed In position as detailed in the drawing. Unless otherwise specified by the Incharge, reinforcement shall be positioned within the tolerance as under:

a) for effective depth 200 mm or less, +10 mm
b) for effective depth more than 200 mm, +15 mm

4.7.2 But in no case shall the cover be reduced by more than 5 mm of that specified. There shall be no compromise on cover for foundation

4.7.3 work.

Reinforcing bars shall be held in position during the placing of concrete by use of PVC or concrete cover blocks (made of equal strength of well-cured concrete in use), steel chair spacers, steel hangers, supporting wires, etc. and secured by tying with an

4.7.4 annealed binding wire of 16 to 18 gauge as approved by the Incharge.

Layer of bars shall be separated by precast concrete spacer blocks or spacer bars. Reinforcement shall be in correct position prior to start of concreting. No reinforcing bar shall be placed on freshly laid concrete for adjusting bar spacing. Care shall be taken to maintain reinforcement in position and keep it clean, throughout the period till

4.7.5 it is embedded in the concrete. For maintaining cover, pieces of broken stone or brick or wooden blocks shall not be used at any stage.

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be

5.0 taken to ensure that at no time is the radius of the bend less than 4

bar diameters in case of plain mild steel or 6 bar diameters for deformed bars. Care shall be taken when bending back bars to ensure that the concrete around is not damaged/disturbed.

MEASUREMENTS

Reinforcement shall be measured as follows:

1. Lengths of different diameters of bars actually used including authorised overlaps shall be measured nearest to a centimeter and their weight calculated.
   a) If steel is procured by the contractor, weight per metre given in table 3.9 shall be used.
   b) If material is supplied by the client free of cost on tonnage basis to the project site, per metre weight for each diameter of the bar shall be fixed by the incharge from actual stocks of steel available at site or weight per meter given in table 3.9 shall be used.
2. Chairs and spacer bars shall not be measured and paid. For reconciliation purpose it will be taken into account.
3. In case of welded coupled joints, measurement for payment shall be equivalent to the length of overlap, as per design.
4. Price build-up shall include, in addition to cost of material,
   a) Cover blocks of PVC or concrete.
   b) Cutting, bending, placing and fixing in position.
   c) Binding wire as approved.
   d) Cleaning of bars.
   e) Unloading, weighing cost (to conform the weight of steel) and storing the same in proper forms and conditions on platforms.
5. In case the material is supplied by the owner free-of-cost, it shall include the following in addition to 4a) to 4d) above.

   Transportation from owner's store to work site and returning surplus material back to store.
6. For purpose of reconciliation, maximum wastage permitted shall be 3% of the actual material used (returnable to owner). Balance shall be charged at 1.5 times the actual market rates as penalty.

SECTION – II C

FORM WORK

1.0 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the Incharge for his direction/approval. However as a general rule more stringent specification shall take precedence.

1.	IS 303	Specification for plywood for general purpose.
2.	IS 456	Code of practice for construction and design of reinforced concrete.
3.	IS 2751	Code of practice for welding of M.S bars used for RCC
4.	IS 3696	Safety Code of scaffolds and ladders :
	Part 1	Scaffolds
	Part 2	Ladders
5.	IS 4014	Code of practice for steel (part 1 & 2) tubular scaffolding
6.	IS 4082	Recommendation on stacking and storage of construction materials
7.	IS 8989	Safety code of erection of concrete formed structures

1.2 Quality assurance

Contractor shall assume and take upon himself to

a) Design, construct, erect, maintain and struck form work proprietary or custom made

b) Form work shall provide required

- Shape, size and finish
- Rigidity and durability during placing(live levels)
- Rigidity and durability for receiving fresh concrete
- Leak proof water tight joints/junctions
- Easy removal without disturbing concrete
- Provide easy access for handling and placing

c) Form work shall provide safety and shall have adequate access for concreting

d) Workers shall work with required safety measures such as safety belts,

1.3 Experience

The contractor shall provide

a) Site supervisors and foremen qualified and experienced atleast 5(five) years on similar nature of form work.

b) Semi skilled/skilled labour shall be of minimum experience of 5(five) years in doing similar nature of form work

1.4 Examination of strata

The contractor shall examine, and convince himself prior to start of work that strata is firm, rigid and safe to erect scaffold. In absence, same shall be prepared by him and then work shall proceed. If it is not possible due site condition, method of erection support etc. shall be detailed and got approved from Incharge prior to start. In any case responsibility of formwork shall be that of the contractor.

2.0 MATERIAL

2.1 Timber

a) Jungle wood timber in form of planks, battens (runners), ballies, strong durable without cracks, able to sustain warping, twisting and distortion shall be allowed in work for type of requirements.

b) Teak wood /good quality jungle wood shall be used for special decorative moulds. Moulds may be smooth planed or finished with laminate

2.2 Steel

Standard rolled steel sections shall be used with due fabrication of standard special moulds, unitised form work scaffolds, staging etc.

2.3 System

Patented proprietary designed metal (Steel, aluminium or fiber glass) form work best suited for type of work under taken and its requirements shall be used.

2.4 Wire nails confirming to IS and mating needs shall be used.

2.5 Bolts / Nuts /Clamps

MS bolts, nuts, clamps standard or purpose made shall be used. Use of these shall not be harmful to concrete and shall be easily removable or If left In concrete shall be inert to concrete in all respect.

2.6 Form release Agents

Emulsion and oil or chemical agent being used shall not react with reinforce concrete at any stage. No chemical reaction shall take place which may be harmful to reinforcement concrete for its durability strength. These shall not produce any stain and shall not stick to concrete surfaces which will reduce further bonding strength of masonry mortar, painting etc.

3.0 SCOPE OF WORK

3.1 Designing

The contractor shall draw, prepare and submit method of statement backed by designed calculations, taking into account the points noted in clause 1.2 here above at least six weeks prior to the starting of activity. Required drawing and sketches shall be

enclosed along with statement for the proposed area to be taken up for working. The statement shall give

- Loadings considered
- Materials proposed
- Repetitions expected
- Staging/supporting arrangement
- Deployment of proprietary metal form work system.
- Method of handling

It shall be responsibility of the contractor to get the design approved from Incharge atleast four weeks prior to start of form work.

3.2 Equipments

The contractor shall provide required tools, plants, equipments including its proper maintenance during construction at site.

3.3 Proprietary metal formwork

The contractor shall arrange to provide proprietary system metal formwork applicable/adoptable to various areas of works. He shall be responsible to deploy with required mechanism for handling, shifting, transporting placing in position.

3.4 Supervision

The contractor shall be responsible to provide experienced foremen (atleast Five years) in supporting/executing similar nature and magnitude of work. He shall be able to read drawings and should be capable of guiding and getting work executed to quality.

3.5 Labour

The contractor shall provide experienced skilled carpenters to carryout work with system of formwork deployed and necessary plants and equipment shall be made available at site.

4.0 WORKMANSHIP

4.1 Form work shall be classified namely as follows :

a) Textured or decorative finish

b) Fair-faced finish

c) Rough finish

4.2 In BOQ, the contractor shall account for all material and labour etc. to achieve the above finishes to the satisfaction of the Incharge in his quoted price.

1. Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting.
2. Joints shall be water-tight and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.
3. Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedges shall

be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.

4. Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardised in size for easy replacement and universal use at site.
5. Props shall be of steel only. Teak ballies may be permitted with written permission of the Incharge for specific use. Size and verticality shall be approved by the Incharge. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be a proper steel plate or timber plank, for equal distribution of load.
6. In repeated use, panels shall be clearly marked for using at defined locations.
7. Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.
8. In fill pieces and panels shall be well dressed, leveled and jointed with main formwork so as to achieve smooth, even natural finish.
9. Props, Soldiers, wallings, Shores, bearers, Clamps, wall & ties etc. shall be at required spacings.
10. Props, shores shall be securedly braced with firm bearing.
11. Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.
12. Sloping, brackets, chajjas etc shall be well secured and firmly restrained.
13. Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.
14. Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.
15. Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.
16. Heavy, medium and light duty props shall not be mixed up.
17. Beams and slabs shall have camber of 4 mm per metre or as directed by the Incharge.
18. All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a triangle of 25x25mm.
19. Props of steel or timber (if approved in writing) shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers. If use of timber is permitted, planks of 100 x 25 mm shall be used and shall be secured by nailing them

to timber props. No other material shall be permitted.

20. At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.
    (a) Openings for cleaning prior to start of concreting.
    (b) Pouring points shall avoid high drops and provide easy access to vibrator needles.
21. Surfaces shall be treated with mould releasing oil or emulsion as approved by the Incharge prior to reinforcement laying.
22. The following point shall be observed very carefully:
    (a) Joints of moulds shall be water tight. It is easy to check from bottom and make sure that no light is visible.
    (b) Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.
    (c) Tie bars in beams, walls and columns shall be at the correct place and fully tight.
    (d) Wedges shall be fully secured and nailed with head left out for easy removal.
    (e) All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
    (f) Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.
23. Opening/inserts

    All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.
24. In case of multistoried building, any upper floor shall be suitably supported on atleast one floor below the same or as approved by the Incharge. The concreting of upper floor shall be done only after lower floors have attained the strength.

4.3 Checking prior to concreting.

1. All props and struts are plumbed at right spacing properly tightened up and locked.
2. Formwork is correctly aligned and leveled.
3. Stop ends are properly secured and sealed.
4. All ties are properly tightened.
5. All inserts, pockets etc are at desired level and secured.
6. Joints are sealed and no possibility of leakage of grouts.
7. Reinforcement has proper covers and required spacers.
8. All forms are cleaned, free from rubbish, tie wires etc.

9. Proper access for concreting and compaction available.

10. Required guard rails, toe boards are provided.

4.4 Tolerances

4.4.1 Tolerance is a specified permissible variation from lines, grade or dimension given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be considered to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

4.4.2 Tolerances for RCC buildings

1. Variation from the plumb:

   (a) In the lines and surfaces of columns, piers, walls and in arises 3 mm per 2.5 m but not more than 10 mm.

   (b) For exposed corner columns and other conspicuous lines,

In any bay upto 5 m maximum	:	5 mm
In 10m or more	:	10mm

2. Variation from the level or from the grades indicated on the drawings,

   (a) In soffits of slab, ceilings, beam and in arises

In 2.5 m	5 mm
In any bay upto 5 m maximum	8 mm
In 10m or more	10 mm

   (b) For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines,

In any bay upto 5 m maximum	5 mm
In 10m or more	8mm

3. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.

In any bay upto 5 m maximum	5mm
In 10 m or more	10 mm

4. Variation in the sizes and location of sleeves, openings in walls and floors 5mm (except in the case of and for anchor bolts).

5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls - 5 mm + 10 mm

6. Footings

   a) Variation in dimension in plan • 5 mm + 50 mm

   b) Misplacement or eccentricity

   2% of footing width in the direction of misplacement but not more than 50 mm

   c) Reduction in thickness

   5% of specified thickness subject to a maximum of 50mm

7. Variation in steps

		Riser	Tread
a)	In a flight of stairs	3mm	5mm
b)	Consecutive steps	1.5 mm	3 mm

4.4.3 Tolerances in other concrete structures.

1. a) Variation of the constructed linear outline from established position in plan

   In 5 m : 5 mm

   In 10m or more : 10mm

   b) Variations of dimensions to individual structure features from established positions

   In 20m or more : 25mm

   In buried construction : 50 mm

   c) Variation from plumb, from specified batter or from curved surfaces of all structure

   upto 2.5 m : 3 mm

   2.5 m to 5 m : 8 mm

   5m to 10m or more : 12mm

   In buried construction : Twice the above

   d) Variation in cross sectional dimensions of columns, beams, buttresses, piers and similar members

   (-) 5mm (+) 10mm

   e) Variation in the thickness of slabs, walls, arch sections, and similar members.

   (-) 5 mm (+) 10 mm

2. Footings for columns, piers, walls, buttresses and similar members.

   a) Variation of dimensions in plan

   (-) 10 mm (+) 50 mm

   b) Misplacement or eccentricity

   2% of footing width in the direction of misplacement but not more than 50 mm

   c) Reduction in thickness

   5% of specified thickness subject to a maximum of 50mm

4.5 Removal of Form work

1. Forms shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of form work.

   Under normal circumstances and where 53/43 grade 0.P.Cement is used, forms shall be removed after expiry of the following periods:

   a) Walls, columns and vertical faces 24 to 48 hrs
   b) Slabs (props left under) 3 days
   c) Beam soffits (props left under) 7 days
   d) Removal of props under slabs

(i) Spanning upto 4.5 m 7 days

(ii) Spanning over 4.5m 14 days

e) Removal of props under beams and arches

(i) Spanning upto 6 m 14 days

(ii) Spanning over 6m 21 days

For other cements, the stripping time shall be suitably modified in consultation with the Incharge.

2. Where the shape of elements is such that the form work has re-entrant angles, the form work shall be removed as soon as possible after the concrete has set, to avoid shrinkage or cracking that might occur due to the restraint imposed.

3. For precast moulds, the stripping time shall be 24 hours. The mould may be lifted and stored in the yard within 24 hours to 48 hours as approved by the Incharge.

4.6 Maintenance

It shall be responsibility of the contractor to protect, maintain and handover to next contractor / Employer in finished condition. No additional cost due to this shall be paid by the Employer Providing and fixing inserts is part of this

a) On completion of concreting inserts shall be cleaned and required treatment such as oiling, greasing, covering with plastic/plywood boxes, painting etc. shall be carried out by the contractor to approval of the Incharge. Inserts and pockets shall be protected from weathering/or damage in course of construction.

b) Opening and pockets shall be deshuttered with due care not to damage edges, falling of debries within pockets etc. Further all opening and pockets shall be preserved, secured against accident by covering, putting up guard rails, warning notice etc. as approved by the Incharge. Guarding and protecting pockets shall be responsibility of the contractor at no extra cost to contract.

4.7 Cleaning/Stacking

All formwork deshuttered shall be cleaned with a stiff wire brush to remove dust, grout, concrete etc. and if required maintained/repaired prior to being reused. Steel plates, props, frames, proprietary formwork system shall be oiled, greased to protect against rusting, weathering etc.
Plywood and timber form shall also be applied with preservative agent if to be kept for long time without use. It shall be protected against heat, rains etc.

4.8 Measurements

Form work shall be paid for separately as per item details given in BOQ. Wherever it is not specifically stated in description of the item that form work shall be paid for separately, the rate of R.C.C. item shall be deemed to be included in the cost of the form work.

1. Form work shall be measured as the area (in square meters) of shuttering in contact with the concrete.
2. It shall be measured to the nearest centimeter and the areas worked out corrected to second decimal places.
3. No deductions shall be made for openings upto 0.4 sq m in the plan.
4. Form work to secondary beams shall be measured upto sides of the main beams but no deduction shall be made from the form work of the main beam.
5. No deduction shall be made from the form work of column at intersection of the beam.
6. The quoted rate shall be applicable for all working conditions and at all heights, depths or lifts specified in the BOQ. The rate shall include the cost of materials and labour for various operations involved, such as,
    a) Splayed edges, notching, allowance for overlaps and plastering at angles, battens, centering, shuttering, strutting, propping, bolting, nailing, welding, casing, striking and removal.
    b) Filling to form stop chamfered edges or splayed external angles not exceeding 75 mm to footing and 25 mm to beams, columns and like.
    c) Temporary openings in the forms for pouring concrete and removing rubbish.
    d) Dressing with oil/approved emulsion/soap solution to prevent adhesion of concrete with shuttering.
    e) Racking or cutting
    f) Fixing inserts and openings at the correct line and level and any required stage to support the same at the directed height and place.
    g) Platforms, if any, required to keep check on form while the concreting is in progress.
    h) Filling and making joints water-tight to the satisfaction of the EIC.
    i) Cleaning the shuttering.
7. Any work damaged through premature or careless removal of form shall be removed and reconstructed at the contractor's cost.
8. Holes for electrical conduits, hooks for fans and for plumbing are included in the price of items.

SECTION – III

HOLLOW AND SOLID CONCRETE BLOCK MASONRY

1.0 **Hollow and solid concrete blocks** – Shall conform to the requirements of IS: 2185. Specification for hollow and solid concrete blocks except with regard to the mix of cement concrete and sizes of aggregates which shall be as indicated. Hollow blocks shall be sound, free from cracks, broken edges, honey combing and other defects that would interfere with the proper placing of block or impair the strength or performance of construction.

1.1 **Dimensions and tolerances:**

Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, and partition block, and concrete floor units. Concrete block-hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions. The nominal dimensions of concrete block shall be, as follows:

Length	:	400, 500 or 600 mm
Height	:	200 or 100 mm
Width	:	50, 75, 100, 150, 200, 250 or 300 mm.

In addition, block shall be manufactured in half lengths of 200, 250 and 300 mm to correspond to the full lengths.

The maximum variation in the length of the units shall be not more than +/- 5 mm and maximum variation in height and width of unit, not more than +/- 3mm.

1.2 **Classification:**

1.2.1 Hollow (open and closed cavity) concrete blocks.

The hollow (open and closed cavity) concrete blocks shall conform to the following three grades:

a) Grade ‘A’ - These are used as load bearing units and shall have a minimum block-density of 1500 kg / m3. These shall be manufactured for minimum average compressive strengths of 3.5, 4.5, 5.5 and 7.0 N/mm2 respectively at 28 days (See Table 5).
b) Grade ‘B’ - These are also used as load bearing units and shall have a block density less than 1500 kg / m3 but not less than 1000 kg / m3. These shall be manufactured for minimum average compressive strengths of 2.0, 3.0 and 5.0 N/mm2 respectively at 28 days. (See Table 5).
c) Grade ‘C’ – These are used as non-load bearing units and shall have a block density less than 1500 kg / m3 but not less than 1000 kg / m3. These shall be manufactured for minimum average compressive strength of 1.5 N/mm2 at 28 days (see Table 5).
d) Grade ‘D’ – The solid concrete blocks are used as load bearing units and shall have a block density not less than 1800 kg/m3. These shall be manufactured for minimum average compressive strengths of 4.0 and 5.0 N / mm2 respectively (see Table 5).

1.2.2 Physical requirements:

1.2.2.1 Compressive strength – The average crushing strength of eight blocks, when determined in accordance with IS: 2185 shall not less than as specified in Table 3:

Table 5 Physical requirements

Type	Grade	Density of block Kg/mm^3	Minimum Average compressive strength of units	Minimum strength of individual units N/mm^2
Hollow (open & closed cavity) load bearing unit	A (3.5)	Not less than 1500	3.5	2.8
	A(4.5)		4.5	3.6
	A(5.5)	Not less than 1500 but not less than 1000	5.5	4.4
	A(7.0)		7.0	5.6
	B(2.0)		2.0	1.6
	B(3.0)		3.0	2.4
	B(5.0)		5.0	4.0
Hollow (open and closed cavity) non-load bearing units	C(1.5)	Less than 1500 but not less than 1000	1.5	1.2
Solid load	D(5.0)	Not less than 1800	5.0	4.0
Bearing Units	D(4.0)		4.0	3.2

1.2.2.2 Drying shrinkage – The drying shrinkage of the blocks (average of three blocks), when unrestrained, shall be determined in accordance with IS: 2185 and shall not be exceed 0.1 per cent.

1.2.2.3 Moisture movement – The moisture movement (average of three blocks), when determined as described in IS: 2185 shall not exceed 0.09 percent.

1.2.2.4 Water absorption – The water absorption (average of three blocks), when determined in the manner described in IS: 2185 shall be not more than 10 per cent by mass.

Face shells and webs shall increase in thickness from the bottom to the top of the unit. Depending upon the core moulds used, the face shells and webs shall be flared and tapered or straight tapered, the former providing a wider surface for mortar. The thickness of the face shell and web shell is not less than the values given in Table 4.

Table 6 Minimum face shell and web thickness

Nominal block length and width	Face shell thickness	Thickness of web	Total web thickness per course in any 200 mm of walling
	Min.	Min.	Min.
100 or less	25	25	25
Over 100 to 150	25	25	30

Over 150 to 200	30	25	30
Over 200	35	30	38

Subject to the tolerance as specified in 5.4.2.2 and 5.4.4.7, the face of masonry units shall be flat and rectangular, opposite face shall be parallel, and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the blocks.

Blocks with special faces shall be manufactured and supplied as directed by the engineer.

1.2.3. **Curing and drying** - The blocks shall be cured in an immersion tank or in a curing yard and shall be kept continuously moist for at least 14 days. When the blocks are cured in an immersion tank, the water of tank shall be changed at least every four days.

After curing, the blocks shall be dried in shade before being used on the work. They shall be stacked with voids horizontal to facilitate through passage of air. The blocks shall be allowed to complete their initial shrinkage before they are laid in wall.

1.2.4 **Construction of masonry** - For single storeyed buildings, the hollows of blocks in foundation and basement masonry shall be filled up with sand and only the top foundation course shall be of solid blocks. But for two or more storeyed buildings, solid concrete blocks shall be used in foundation courses, plinth, and basement walls, unless otherwise indicated. If hollow blocks are used, their hollows shall be filled up with cement concrete 1:3:6 using 12.5 mm nominal size aggregates.

1.2.5 **Wetting of blocks** - Blocks need not be wetted before or during laying in the walls. In case the climate conditions so require, the top and the sides of the blocks may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar.

1.2.6. **Laying** - Blocks shall be laid in mortar, as indicated and thoroughly bedded in mortar, spread over the entire top surface of the previous course of blocks to a uniform layer of not less than 10 mm and not more than 12 mm in thickness.

All courses shall be laid truly horizontal and all vertical joints made truly vertical. Blocks shall break joints with those above and below for not less than quarter of their length. Precast half length closers (and not cut from full size blocks) shall be used. For battered faces, bedding shall be at right angles to the face unless otherwise directed. Care shall be taken during construction to see that edges of blocks are not damaged.

1.2.7 **Provisions for door and window frames** - A course of solid concrete block masonry shall be provided under door and window openings (or a 10 cm thick precast concrete sill block under windows). The solid course shall extend for at least 20 cm beyond the opening on either side. For jambs of very large doors and windows either solid unit are used, or the hollows shall be filled in with concrete of mix 1:3:6 using 12.5 mm nominal size aggregates.

1.2.8 **Provisions for roof** - The course immediately below the roof slab shall be built with solid blocks. The top of the roof course shall be built with solid blocks. The top of the roof course shall be finished smooth with a layer of cement and coarse sand mortar 1:3, 10 mm thick and covered with a thick coat of white wash or crude oil, to ensure free movement of slab.

1.2.9 **Intersecting walls** - When two wall meet or intersect and the course are to be laid up at the same time, a true masonry bond between at least 50% of the units at the intersection is necessary. When such intersecting walls are laid up separately, pockets with 20 mm maximum

vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these pockets.

1.2.10. **Piers** - The top course of block in the pier shall be built in solid blocks. Hollow concrete block shall not be used for isolated piers, unless their hollows are specified to be filled with cement concrete.

1.2.11. Fixtures, fittings, etc. shall be built into the masonry in cement and coarse sand mortar 1:3 while laying the blocks where possible. Hold fasts shall be built into the joints of the masonry during laying. Holes, chases, sleeves, openings, etc. of the required size and shape shall be formed in the masonry with special blocks while laying, for fixing pipes, service lines, passage of water etc. After service lines, pipes etc. are fixed, voids left, if any, shall be filled up with cement concrete 1:3:6 (1 cement : 3 coarse sand: 6 stone aggregate 20 mm nominal size) and neatly finished.

1.2.12 Finishes - Rendering shall not be done to the walls when walls are wet. Joints for plastering or pointing as specified shall be raked to a depth of 12 mm. Joints on internal faces, unless otherwise indicated, shall be raked for plastering. If the internal faces of masonry are not be plastered the joints shall be finished flush as the work proceeds or pointed flush where so indicated.

Annexure 5-A.1

BLOCK WORK- CONSTRUCTION PRACTICE

1. General

1.1. Introduction

Blocks are either hollow or solid. Generally they are of light weight compared to bricks. Concrete blocks to IS: 2185 (Part 1)-1979 may be used for both load bearing and non-load bearing walls. The wall thickness will vary.

For high thermal insulation, cavity walls having inner leaf of light weight concrete blocks to IS: 2185 (Part 2)-1983 may be used. Each leaf of cavity shall not be less than 100 mm.

Autoclave cellular concrete blocks to IS: 2185 (Part 3)-1984 shall not be used for foundations and for masonry below damp-proof course.

2. Mortars

2.1. Hollow concrete blocks:

Hollow concrete blocks shall be embedded with a mortar which is relatively weaker than the mix used for making blocks in order to avoid formation of cracks. A rich or strong mortar tends to make a wall too rigid thus localizing the effects of movements due to temperature and moisture variations, resulting in cracking of blocks. The recommended proportion of mortar measured by volume is given in Table 1

Table 7 Mix Proportion of mortar for hollow concrete blocks

Sl No Masonry	Type of work	Normal masonry (Cement:Lime:Sand)	Reinforced (Cement: Sand)
1.	Normal work	1 : 1 : 9 to 10	1 : 7 to 8
2.	Exposed to severe conditions; high intensity of loads; plasters; heavily loaded lintels and beams.	1 : 1 : 6 to 7	1 : 4 to 5
3.	Partitions of 10 cm	1 : 1 : 7 to 8	1 : 5 to 6

Note: All mortars shall have a slump of 75 mm.

2.2. Light weight blocks - Light weight blocks shall be embedded with a mortar mix, the strength of which is lower than mix for making blocks, to avoid formation of cracks. A 1:2:9 cement, lime, sand mortar may generally be used; for high intensity of load it shall be 1:1:6. Autoclaved blocks shall be embedded in mortar as specified in Table 1

3. Concrete

3.1. Concrete used for filling hollow concrete block masonry when reinforced shall be 1 cement, 2 ½ sand and 3 coarse aggregate of size ranging from 4.75 mm to 10 mm. The water cement ratio shall not exceed 0.6. When cells exceed, 100 mm on the narrower side, the proportion of mix shall be 1of cement, 2 ½ of sand and 3 ½ of coarse aggregate for reinforced concrete and 1:3:6 plain concrete.

4. Thickness

4.1. For load bearing masonry built with hollow concrete blocks, the thickness of walls shall not be less than the values as obtained from IS: 1905-1987.

4.2. Light weight block in load bearing masonry for external walls in framed construction shall not be less than 200 mm. However, if they are suitably braced by lateral or vertical supports, the thickness can be 100 mm. Non-load bearing hollow block walls shall be not less than 100 mm.

4.3. Autoclaved block walls in framed construction shall also be as per above; except that for load bearing work, the minimum thickness shall be 200 mm; however it can be reduced to 150 mm if properly braced.

5. Lateral supports

Walls made of blocks shall have vertical or horizontal lateral supports at right angles to the face of the wall. Cross walls, plasters or buttress walls shall provide the lateral support.

6. Avoidance of crack formation

6.1. General

The major cracks in the walls or partitions in a structure constructed with blocks, whether they are of hollow of cellular types can be prevented. The preventive measures to be undertaken are covered.

6.1.1. Structural movements

Cracks may arise from alterations in length, the curvature or orientation due to load settlement, thermal expansion or changes in moisture content.

In the case of framed structures, erection of partitions and panel walls shall be delayed wherever possible until the frame has taken up, as much as possible, any deformation occurring due to structural movements.

a) Floor deformation and movement – The floor upon which a partition is built may deflect under load brought on it after the partition is built. Such deflections tend to create a non-continuous bearing for the block leading to cracks in the partition. This can be avoided by embedding wires of 3 mm diameter of mild steel or galvanized steel or welded wire mesh strip in bed joints in cement mortar 1:2 after every 900 mm to 1200 mm height.

b) Ceiling deflection and movement – A ceiling above a partition will may deflect under loads applied after its erection or through thermal or other movements. To avoid cracking as a result of such deflection, the partition wall shall be separated from the ceiling by a gap or by a layer of resilient material or lean mortar. When this cannot be done as in the case of plastered finishes,

the risk of cracking may be reduced by forming a cut between the ceiling plaster and the wall plaster.

c) Deflection or movement of structural abutments – The walls, columns or other structural elements against which the wall or partition abut, may deflect or move because of load, settlement, shrinkage or thermal effects. In order to avoid cracking of walls or partitions as a result of such movements, a slip joint shall be provided where possible, preferably packed with a resilient mortar or lean mortar.

d) Cracks in partition walls may occur at corners of door and window frames at lintel level or sill level. It may therefore be desirable to provide a nominal reinforced concrete band beam (see Fig. 1) at sill level and vertical reinforced concrete stud at either side of vertical members of frames which may in addition provide sufficient anchorage for hold fast.

6.1.2. Control of wall movements accompanying temperature and moisture changes Cracking in concrete masonry walls is often due to tensile stresses which develop when wall movements accompanying temperature and moisture change are restrained by other elements of the building or when concrete masonry places restraint on the movement of adjoining elements.

There are three methods of controlling cracking in concrete masonry structures :

(1). Specifying a limit on the moisture content of masonry units at the time of delivery and construction;

(2) Incorporating steel reinforcement either in the form of nominal bond beams or horizontal joint reinforcement and,

(3) Providing control joints to accommodate the movement of masonry. In all concrete masonry construction, it is essential to employ only moisture controlled units. Their use, combined with the provision of control joints is generally adequate to prevent cracking in concrete masonry walls. However, bond beams or joint reinforcement, or both in different locations as considered suitable may also be used in addition to the above.

6.1.3. Nominal bond beams - Bond beams, the use of which as structural members have been referred shall also serve as a means to crack control. Normal bond beams shall be built in the same manner as the structural bond beams with a minimum reinforcement of two 8 mm mild steel bars or two 6 mm dia high strength deformed bars. Their value for this purpose is due to increased strength and stiffness they provide to a masonry wall. As a means of crack control, the area of influence of bond beam shall generally be assumed to be extending 600 mm above and below its location in the wall. In walls without openings, they shall be placed at 1200 mm apart and may be of any length up to a maximum of 18 m (see Table 2).See Fig. 1.

Nominal bond beams shall be discontinuous at control joints, but practice here varies depending on the structural requirements. Dummy joints shall be formed when a bond beam is continuous at a control joint.

6.1.4. Joint reinforcement - Horizontal joint reinforcement serves much the same purpose as bond beams in crack control. It increases stresses to cracking. Due to closer spacing adopted, joint reinforcement may be more effective in crack control than bond beams.

a) Joint reinforcement shall be preferably be fabricated from galvanized steel to IS 280:1978 and shall consist of two or more smooth or deformed longitudinal wires 3 mm dia or larger weld connected with 2.8 mm dia or larger cross wires. The out-to-out spacing of longitudinal wires shall be 30 mm less than the width of masonry skills. Cross wires shall be welded at a pacing of 150 mm for smooth wires and 400 mm for deformed wires. Where splice in wires is necessary, it shall be lapped to a length of at least 300 mm.

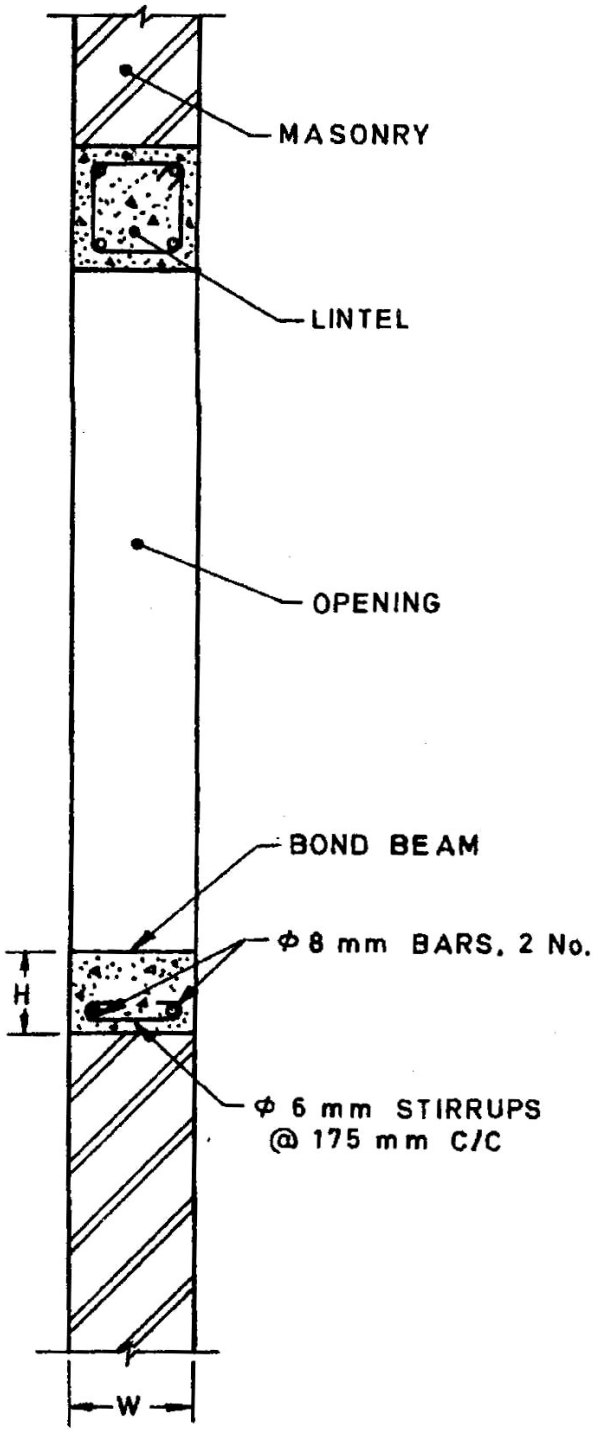
b) The reinforcement shall be embedded in horizontal joints at intervals of 900 mm to 1200 mm depending on panel length, height and the number and type of wall openings. (See Table -2)

c) Joint reinforcement shall be used in conjunction with cement mortar not weaker than 1:2 mixes. In walls exposed to action of weather, the reinforcement shall have a mortar cover of not less than 15 mm.

d) Notwithstanding the above, location of joint reinforcement shall be as follows :

1) Place the joint reinforcement in the first and second bed joints immediately above and below wall openings ;
2) It shall not extend less than 600 mm beyond the openings to end of the panel whichever is smaller ;
3) Place joint reinforcement within two or three courses immediately below the top of the wall ;
4) Joint reinforcement shall not be located closer to a bond beam than 600 mm ; and
5) Joint reinforcement shall be interrupted at control joints.

Notes: (1) When bond beams spaced at 1200 mm are used in place of joint reinforcement, control joints shall be spaced at 18 m. (2) Where reinforcement has not been provided, the ratio L / H of wall panel shall conform to IS: 1905-(1987)



$H \nless 80$ mm
$W \times H \nless 1\,200$ mm^2

Fig. 1 Nominal reinforced concrete bond beam at sill level

Table 2: Recommended length top height ratios for concrete block masonry

Sl No	Wall panel	Vertical spacing of joint reinforcement		
		900 mm	1000 mm	1200 mm
1	Length of panel (L) Irrespective of height (H) Max.	18 m	15 m	12 m
2	Ratio L/H, Max			
a)	200 mm thick wall	3.0	2.75	2.50

b)	300 mm thick wall	2.25	2.00	1.75

6.1.5. Control joints - Control joints are employed to reduce restraint by accommodating movement of masonry wall or movement of structural elements adjacent to the wall, and thus to control cracking. They are in fact vertical separations built into the wall at locations where cracking is likely due to excessive horizontal stresses. The spacing along the wall length depends upon:

(a) Expected movements of the wall and other elements

(b). Resistance of the wall to horizontal stresses

(c) The extent and location in the wall of doors, windows, recesses, chases and other causes of stress concentration. Some typical methods of control joints are shown in Fig 2 and Fig. 3.

6.2. Bonded beams and studs used on structural members

6.2.1. Reinforced concrete structural bond beams may be used in concrete block masonry to meet the requirements of unusual stress conditions. Examples are as below:

a) In buildings in earth-quake regions ;

b) In buildings in areas where severe wind storms occur ;

c) In buildings in areas where unfavorable soil movements and soil subsidence occur ; and

d) In buildings where walls are subjected to excessive vibration or to heavy loads.

In all such cases, it is necessary to provide more than nominal stability for all types of masonry walls.

6.2.2. Bond beams shall be built integrally with block masonry or with special U-shaped lintel blocks slung together with reinforcing steel placed in the core of hollow of blocks filled with M15 concrete. The reinforcement shall conform to IS: 456-2000; but in no case shall be less than two 12 mm dia mild steel bars. The beams are discontinuous at control joints; but the joints should be designed to transfer forces along the wall.

6.2.3. Bond beams may be provided at any of the following locations depending on the conditions as described in 6.2.1

(a) At floor level; (b) At top of all door and window openings (in which case they serve as lintels over them); (c) Below the sill in all window openings and (d) At plinth level.

6.2.4. Apart from the horizontal bond beams, vertical reinforced concrete studs may also be provided at corners, at wall openings and at regular intervals between wall openings. The studs shall be tied in with bond beams.

Non-structural use of bond beams is already covered 6.1.3

7. Preparatory works

Wetting of blocks

7.1. The blocks need not be wetted before or during the laying of the blocks. In case the climatic conditions so require, the top and sides of the blocks may be slightly moisture so as to prevent absorption of water from the mortar and ensure development of the required bond with the mortar.

7.2. Scaffolding - Scaffolding shall be on the same lines as brickwork, suitably modified where necessary.

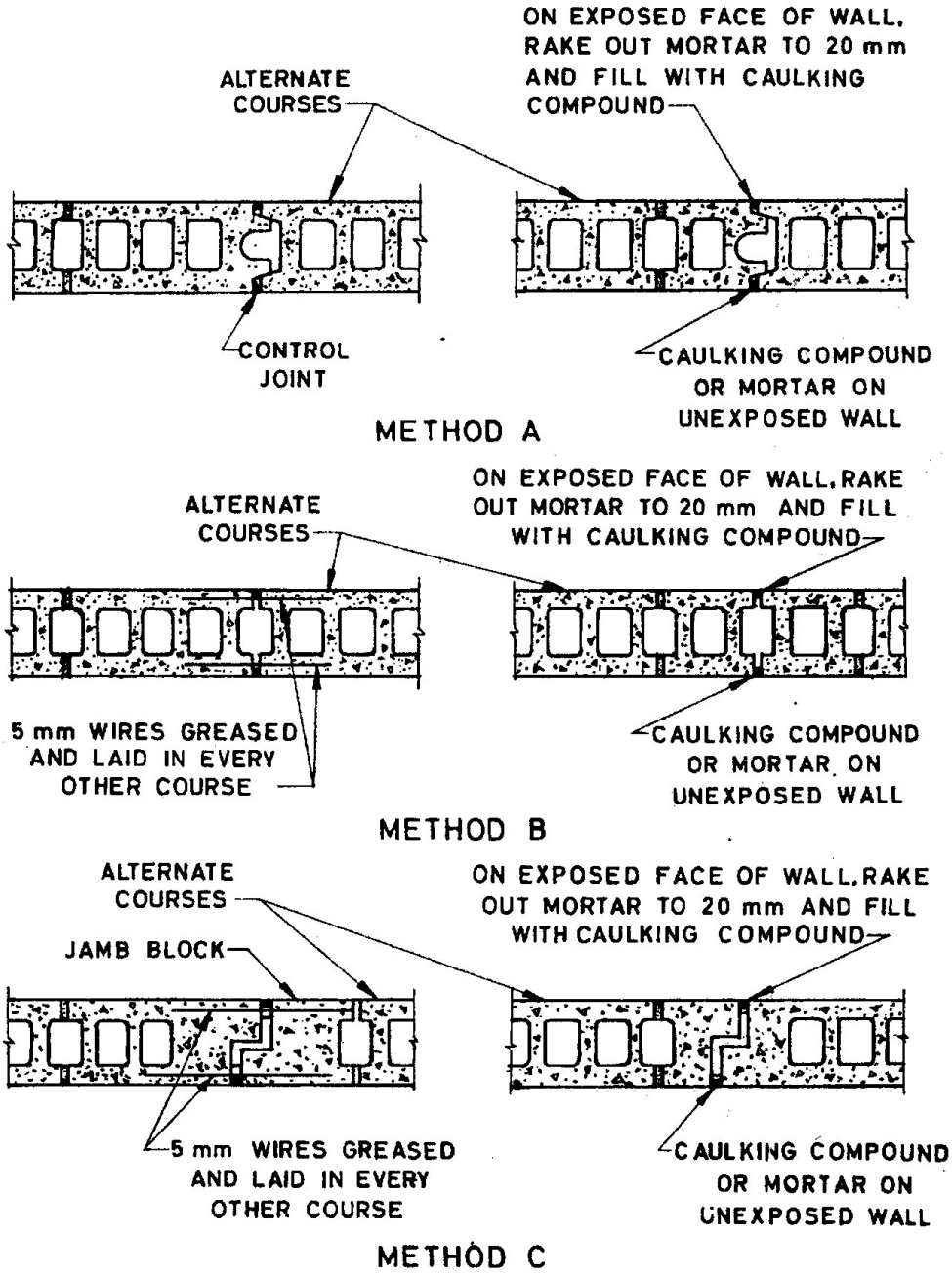
8. Laying of Concrete Blocks

8.1. First Course - The first course of concrete block shall be laid with great care, making sure that it is properly leveled, aligned and plumbed, to assist in obtaining a straight and truly vertical wall. Before laying the first course, the alignment of the wall shall be marked on the d. p.c. The blocks for this course shall be laid dry, that is, without mortar along a string stretched between properly located corners of the wall in order to determine the correct position of blocks including those of the cross walls jointing it and also adjust their spacing. When the blocks are in proper position, the two corner blocks shall be removed, a mortar bed spread and these blocks re-laid back in place truly level and plumb. The string shall then be stretched tightly along the faces of two corner blocks and the faces of the intermediate blocks adjusted to coincide with the line. Thereafter each block shall be removed and re-laid over a bed of mortar. After every three or four blocks are laid the correct alignment and vertically be checked.

8.2. Construction - The construction of walls may be started either at the corners first or started from one end proceeding to the other end.

If the corners are built first, they shall be built four or five courses higher than the centre of the wall. As each course is laid at the centre, it shall be checked for alignment and level and for being plumb. Each block shall be carefully checked for alignment with a straight –edge to make sure that the faces of the blocks are in the same plane.

Fig. 2 – Control joints in concrete block masonry construction


ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
ALTERNATE COURSES
CONTROL JOINT
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL
METHOD A
ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
ALTERNATE COURSES
5 mm WIRES GREASED AND LAID IN EVERY OTHER COURSE
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL
METHOD B
ALTERNATE COURSES
JAMB BLOCK
ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
5 mm WIRES GREASED AND LAID IN EVERY OTHER COURSE
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL
METHOD C

8.2.1. Each course, in building the corners, shall be stepped back by a half-trick and the horizontal spacing of block shall be checked by placing a mason's level diagonally across the corners of the blocks. A storey rod or course pole, suitably marked provides an accurate method of finding the top of the masonry for each course.

8.2.2. When filling in the wall between corners, a mason's line shall be stretched from corner to corner for each course and the top outside edge shall be laid true to this line. The manner of handling or gripping the block shall be such as to position the block properly with minimum adjustment.

8.2.3. To ensure satisfactory bond, mortal shall not be spread too far ahead of actual laying of the block as it will stiffen and lose its plasticity. As each block is laid, excess mortar extruding from the

Joints shall be cut off with a trowel and thrown back on the mortar board to be reworked into fresh mortar. If the work is proceeding rapidly, the extruded mortar cut from the joints may be applied to vertical face shells of the blocks just laid. If there be any delay long enough for the mortar to

stiffen on the block, the mortar shall be removed to the mortar board and reworked. Dead mortar that has been picked up from the scaffold or from the floor shall not be used.

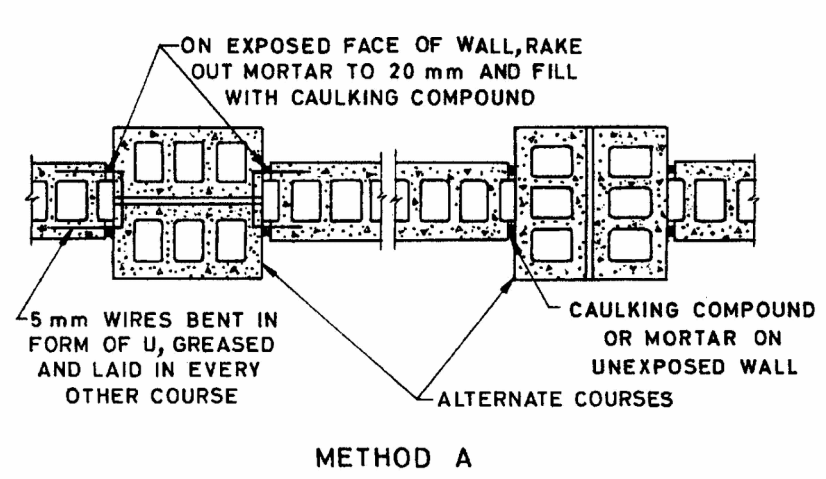

ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
5 mm WIRES BENT IN FORM OF U, GREASED AND LAID IN EVERY OTHER COURSE
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL
ALTERNATE COURSES
METHOD A

Fig. 3

8.3. Closure block - When installing a closure block, all edges of the openings and all four edges of the closure block shall be buttered with mortar.

The closure block shall be carefully lowered into place. If any mortar falls leaving an open joint, the closure block shall be removed, fresh mortar applied and the operation repeated.

9.1. Door and window frames shall be attached to the surrounding masonry either by conventional method or by 200 mm flooring nails with screwed ends fixed directly into the block, after the frame has been edged into the opening at every nailing position. The number of nails depends on the dimensions of the frames. The nails shall be spaced at a maximum of 400 mm apart and the first nail shall not be farther than 200 mm from the corner.

Frames may be attached to the masonry by holdfasts anchored in the vertical reinforced concrete studs provided to the frames.

9. Provision for door and window frames

10. Provision for roof

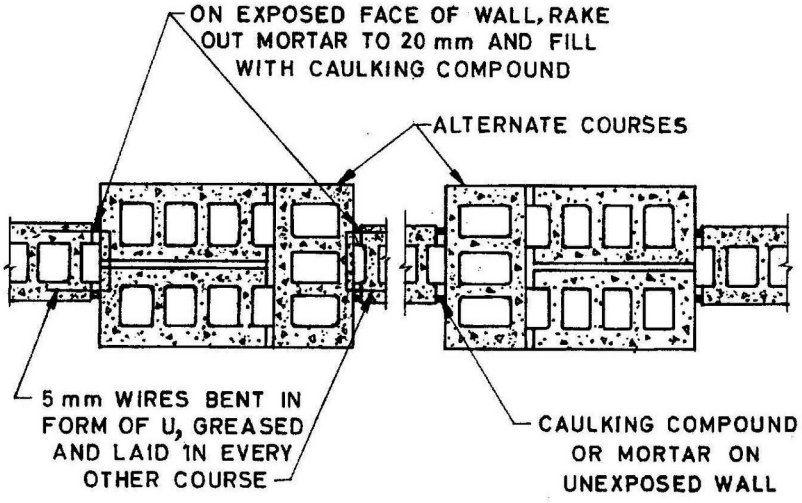
10.1. The top of the roof course shall be finished smooth with a thin layer of 1:3 cement mortars and covered with a coat of crude oil or craft paper or oil paper to ensure free movement of the roof.

11. Intersecting wall

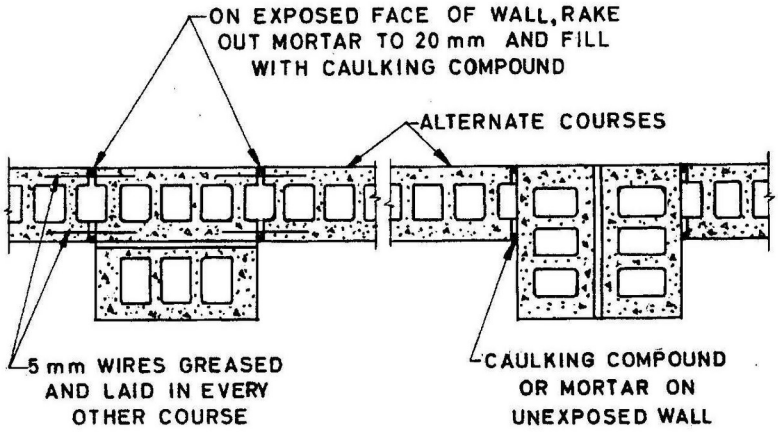
11.1. Load bearing walls - When two load bearing walls intersect and courses are to be laid up at the same time, a true masonry bond between 50 per cent of the units at the intersection is necessary. When such walls are laid up separately, pockets with maximum 200 mm vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built in to these pockets.

11.2. For non-load bearing walls same bonding methods as for load bearing walls may be used.

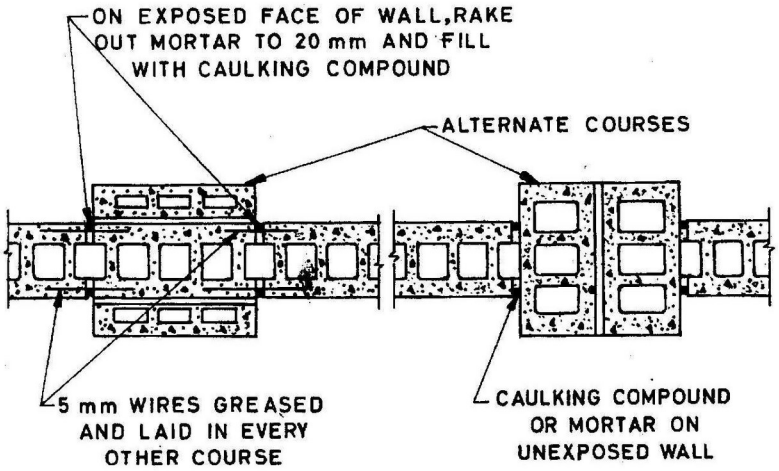
12. Renderings and other finishes - All finishes shall be as specified in Section 12 Finishing Work, as the case may be.


ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
ALTERNATE COURSES
5 mm WIRES BENT IN FORM OF U, GREASED AND LAID IN EVERY OTHER COURSE
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL

METHOD B

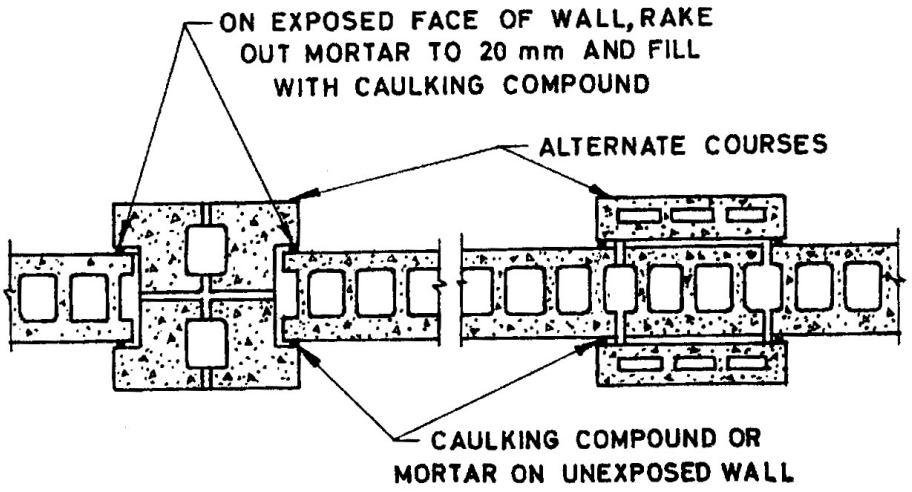

ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
ALTERNATE COURSES
5 mm WIRES GREASED AND LAID IN EVERY OTHER COURSE
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL

METHOD C

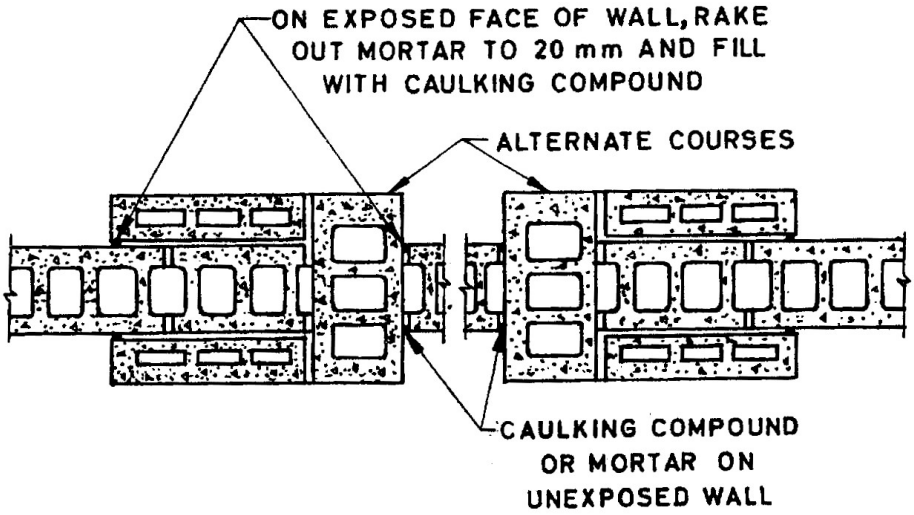

ON EXPOSED FACE OF WALL, RAKE OUT MORTAR TO 20 mm AND FILL WITH CAULKING COMPOUND
ALTERNATE COURSES
5 mm WIRES GREASED AND LAID IN EVERY OTHER COURSE
CAULKING COMPOUND OR MORTAR ON UNEXPOSED WALL

METHOD D

Fig. 3


ON EXPOSED FACE OF WALL, RAKE
OUT MORTAR TO 20 mm AND FILL
WITH CAULKING COMPOUND
ALTERNATE COURSES
CAULKING COMPOUND OR
MORTAR ON UNEXPOSED WALL

METHOD E



METHOD F

Fig. 3 – Plasters with control joints in concrete block masonry construction

Annexure 5-A.2

CONSTRUCTION PRACTICES OF IN-SITU WALLS WITH SOIL CEMENT

1. General

1.1. This type of in-situ construction with soil cement shall be limited to single storey construction with a wall height not exceeding 3.2 mm and a minimum wall thickness of 300 mm for load bearing and 200 mm for non-load bearing walls.

1.2. The procedure described herein may also be followed for rammed in-situ wall construction with unstabilized soil, provided the surfaces of the wall are protected by a waterproof mud plaster.

2. Soil

2.1. Raw soil used for soil cement shall be free from deleterious contents, such as organic matter of vegetable origin, mica, etc. Black cotton soil may not be used from economy considerations. Soil shall conform to the following requirements:

Sand content, percent by mass	35, min
Plasticity index, percent	8.5 to 10.5
Total soluble salts, percent by mass	1, max

Sodium salts, percent by mass	0.1, max
Liquid limit, percent	27, max

Note: Sand content is the fraction of sand of the soil that passes 425 micron is retained on 75 microns IS sieve. More than half the material is smaller than 75 micron by mass.

2.2. Soil shall be prepared as per IS 2110: 1980. Cement shall be mixed in proportions as given below:-

(a)For construction of walls 2.5 to 3.5 per cent by mass of dry soil depending on the density to be obtained. For construction of walls below plinth level and for copings. 5 to 7.5 per cent by mass of dry soil, so that the crushing strength of blocks mate shall not be less than 1.4 N/mm2 (14 kg/cm2) for dry condition.

For calculation purposes the unit weight of dry soil shall be taken as 1 300 kg/m3. Properties of soil cement shall be as in IS 2110: 1980.

2.3. Preparatory work:

2.3.1. Shuttering - Any timber planks suitable in local practice may be used for shuttering. The planks shall not be less than 200 mm in width and 50 mm in thickness. A typical arrangement is shown in Fig. 4

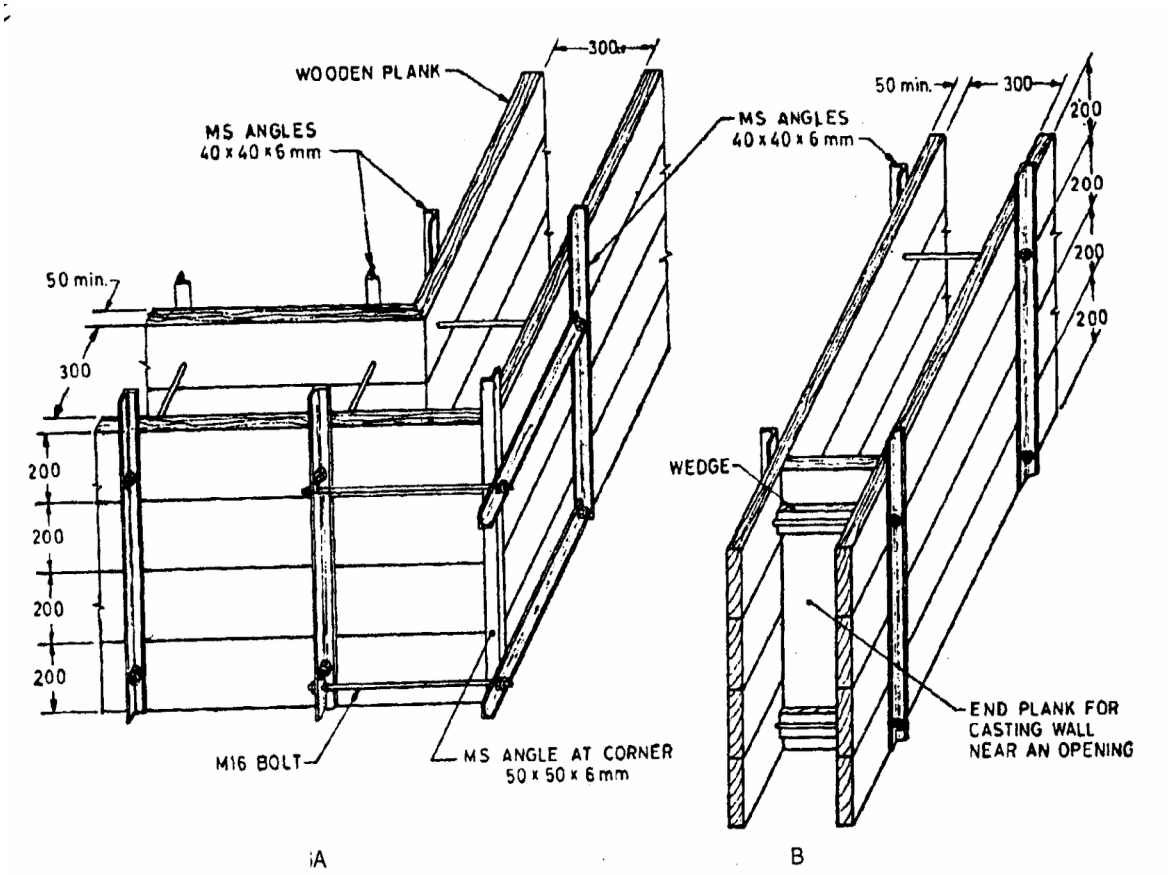


Fig. 4 – Typical details of shuttering for 300 mm thick wall

Note: If the thickness of the wall is greater than 300 mm, shuttering details will have to be suitably modified. The shuttering shall generally be in lengths ranging from 1.8 m to 3.3 m. The height of the shuttering for one lift shall be about 600 mm clear for casting the wall plus 200 mm for holding on to the portion of the compacted wall below in the previous lift. The shuttering may be lifted immediately after first lift is well compacted and the shuttering for next lift arranged.

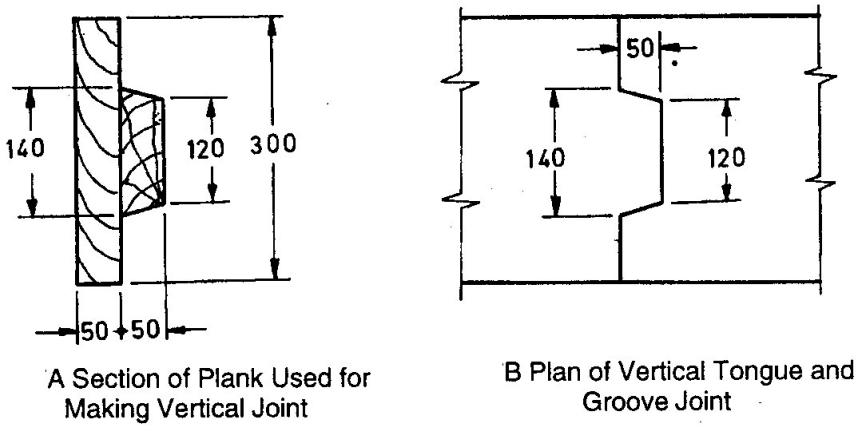
3. Wall constructions

3.1. Preparation of soil - After the shuttering is erected, the moist stabilized soil shall be poured into the shuttering in layers of 75 mm at a time. The layer shall be uniform in depth. To control his depth, templates may be used.

3.2. Compaction - Compaction shall be done by iron rammers. Compaction shall be started at the side and worked inwards. Ramming of the sides shall be evenly distributed to avoid tilting of the shuttering. Verticality of the shuttering shall be checked as compaction proceeds.

3.3. Curing - The walls shall be cured for 15 days after removal of shuttering. Curing shall be done by slight sprinkling of water at regular intervals.

3.4. Joints - Vertical joints shall be provided at a spacing of not more than 2 m apart. Vertical joint shall be staggered. Fig. 5 gives details of joint.



A Section of Plank Used for Making Vertical Joint

B Plan of Vertical Tongue and Groove Joint

All dimensions in millimetres.

Fig. 5 – Typical details of construction joints in in-situ of the soil, cement walls of 300 mm thickness

Horizontal joints shall be formed by finishing smooth the rammed surface at the end of each lift.

3.5. Fixing frames - Frames for door and windows shall be fixed by iron hold fasts inserted in the wall before-hand.

3.6. Bearing of roof - Where light roof frame work is to rest on the wall, the portion of the wall directly below it shall be built with bricks laid in cement mortar 1:6 for a depth of 150 mm; or bricks made out of 7.5 per cent soil cement. Beams shall rest on cement concrete bed plates. Trusses or flat roofs shall rest on brick bearing course to a depth of 150 mm laid in cement mortar 1:6.

3.7. Lintels - Reinforced brick or cement concrete lintels may be used. The space above the lintels shall be filled either with soil cement rammed in-situ, or precast soil cement blocks laid in cement in mortar mix 1:6.

3.8. Parapet - The parapet shall be of brick work. A drip course shall be provided to drain rain water from parapet and away from the lower portions of the walls on to the roof surface. The plaster finish of the roof shall be continued from the roof surface right up to the drip course in the parapet.

3.9. Plastering - Cement plaster of mix hot leaner than 1:5 shall be used. It shall be applied after drying the wall for four weeks at least. The wall surface shall be given a neat cement wash before applying plaster.

4. Preparation of mud plaster:-

4.1. Add cutback bitumen to IS 217: 1988, grade 80/100 to mud with BHUSA which is allowed to rot for a week. About 60 kg of 'Bhusa' should be added to a cubic meter of mud. Bitumen should be around 40 kg/m3 of soil used.

4.2. Surfaces to be plastered shall be moistened before application of mud plaster.

SECTION – IV

PLASTERING WORK

1.0 INDIAN STANDARDS

Work shall be carried out as per the latest issue of Indian Standards and Code of Practices. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/ conflict noticed shall be directed to the In-charge /Employer for direction/approval. However as a general rule more stringent specification shall take precedence.

1.	IS 383	Specification for coarse and fine aggregates for natural sources for concrete.
2.	IS 412	Specifications for expanded metal steel sheets for general purposes.
3.	IS 1542	Specifications for sand for plaster
4.	IS 1661	Code of practice for application of cement and cement lime plaster finishes.
5.	IS 2402	Code of practice for external rendered finishes
6.	IS 2645	Specifications for integral cement water proofing compound
7.	IS 8112	Specification for 43 grade OPC.
8.	SP 27	Handbook of method of measurement of building works.

2.0 MATERIALS

2.1 Cement

2.1.1 Cement shall be ordinary Cement conforming to IS and of grade 43.

2.2 Water

2.2.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalis, acids, salts so as not to weaken mortar.

2.2.2 Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456 are reproduced for ready reference in table 1 of IS 456.

2.3 Sand (coarse sand FM above 2.25 & Fine sand F M more than 1.25) shall conform to IS 1542 specification for sand for plaster. For white or coloured renderings, only quartz or silica sand shall e used. For textured finishes produced by treatment of freshly applied final or finishing coat with a tool coarser, particles used shall be screened through 3.35 mm IS sieve or 2.36 mm IS sieve. For torn texture a slightly larger portion of material coarser than 4.75 mm IS sieve shall be used.

2.4 Aggregate shall conform to IS 383.

2.5.1 Integral water proofing compound shall conform to IS 2645 (specification for integral water proofing compound).

2.6 GI Chicken Mesh

GI Chicken mesh of 20 gauge as approved shall be used over junctions of concrete and masonry or two dissimilar materials about 150mm wide fixed with GI wire nails etc. as directed by the Incharge.

Precaution - Any cracks which appear in the surface and all portions which sound hollow when lapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the engineer.

i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitably tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green.

ii) To prevent surface cracks appearing between junctions of column/ beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

3. MORTARS

3.0.1 Mortars shall be prepared by mixing fine graded aggregate with cement, the lime or a combination of these in the proportion specified for respective items of work as detailed in the BOQ. Mixing or mortars shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the Incharge

3.0.2 Mortars shall be specified by proportion only and not by strength. Volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 cu m. Boxes shall be of size 40 x 35 x 25 cm. These shall be marked as mortar mixing boxes by red paint and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.

3.1 Cement mortar

3.1.1 Cement mortar shall be prepared by mixing cement and sand in specified proportions. Proportioning shall be carried out as detailed above and shall be added suitably to allow for bulkage if required. Bulkage shall be determined as specified in IS 2386 Part III. Cement and sand added to mixer shall be thoroughly mixed and water shall be added to it gradually. After addition of water the mixer shall run for a minimum of 3 minutes. The mortar mixed shall be consumed within 30 minutes of its mixing.

4.0 WORKMANSHIP

Work shall be carried out as per recommendations of code of practices IS 1661 and IS 2402.

4.1 Preparation of mortar mix

4.1.1 The material used in preparation of plastering mixes shall be measured by volume using gauge – boxes or by weight.

4.1.2 When cement is measured by weight, 1440 kg of material shall be taken equivalent to one cubic meter. p

4.2 Mixing

4.2.1 Mixing shall be done mechanically. Each mortar batch shall be used within half an hour. Hand mixing if permitted as special case shall be carried out on a clean, watertight platform. The mixing operation shall be continued with addition of necessary quantity of water until a uniform appearance and consistency of mortar is obtained.

4.2.2 Cement and sand shall be mixed dry in required proportion to obtain a uniform colour and water shall then be added to get the required consistency for the plaster.

4.3 Method of plastering:

4.3.1 Surface to be plastered must be clean and free from dust, loose material, oil, grease, mortar droppings, sticking of foreign matter, traces of algae, etc. It is very important to ensure that there should not be any chance of the plaster getting debonded due to presence of materials harmful for bonding.

4.3.2 Raking out of joints is expected to be carried out along with masonry but it should be checked thoroughly so as to receive good key.

4.3.3 Walls should be sufficiently damp prior to plastering. Water from plastering mortar must not be absorbed by masonry under any condition.

4.3.4 Any unavoidable projections in masonry and concrete surfaces shall be chiseled back. Care shall be taken that surrounding surfaces are not damaged and reinforcement is not exposed.

4.3.5 Thickness of one coat should not be more than 15 mm and less than 8 mm for single coat finished plaster.

4.3.6 In case of multi coat plaster, sufficient time shall be allowed for the undercoat to harden (cured, dried and shrunk properly) before subsequent coats are applied.

4.3.7 Undercoats shall be scratched or roughened before they are fully hardened to form a mechanical key.

4.3.8 The method of application is also important and hence it is recommended that the mix be thrown on the surface rather than stuck with trowel. This increases the adhesion.

4.3.9 Independent double legged scaffolding free of masonry shall be provided. Scaffolding should be rigid, allowing free and safe movement on the platform and it should be at sufficient distance or height from the working areas. Scaffolding with railing gives more confidence to workers and improves the quality of work.

4.3.10 Actual plastering shall be undertaken only on the approval of the Incharge. Plaster work should only follow the steps mentioned below:

a. Surface must be thoroughly cleaned.

b. Plaster area must be provided with level dabs or sports allowing working and checking with 2-3 m straight edge. Depth of plaster must not be less than 8 mm at any point.

c. Required concealing services must be completed and tested.

d. No further cutting of masonry must be required.

e. Repairs carried out to masonry or concealing work must be cured and dry.

f. Surface must be sufficiently damp.

g. Plaster dabs are checked for plumb and level by the Incharge or his representative.

h. Joints, concealing and repairing areas must be covered with 20 gauge GI chicken mesh as per the Incharge's instruction.

4.3.11 Corners, external or internal, shall be finished along with final coat. It is advisable to have rounded corners.

4.3.12 Plaster shall be cured for 14 days by wet curing except in neeru finish plaster. During this period plaster shall be protected from exposure to extremes of temperature and weather.

4.3.13 Plaster shall be leveled and lined by aluminium hollow section, 2-3 m long. (This will give even and leveled surface). There shall not be more than 2 mm difference in level when checked with 3 m straight edge. It is important that enough pressing and beating is done to achieve compact filling of joints and that the area is fully compacted.

4.3.14 Finishing of plaster may be carried out with wooden float (rand has) or trowel led smooth with sheet metal trowels as specified. Care shall be taken to avoid excessive trowelling and overworking of the wooden float.

4.3.15 All corners, internal or external, shall be truly vertical or horizontal. These shall be finished with a proper template to achieve best workmanship for rounding and chamfering as specified or directed.

4.3.16 Plaster shall be cut to correct horizontal or vertical line at the end of the day or if work requires to be suspended for any reason.

4.3.17 It is advisable to limit the area of plaster to 15 sq. m. to avoid cracks due to thermal movements of dissimilar material in contact, it is advisable to provide joints treated with groove or any other detail as suggested. These joints, if not, specified shall be treated with 150 mm wide reinforcing chicken mesh (approved by the Incharge) fixed over joints by GI nails and the area plastered.

5.0 TYPE OF PLASTER

5.1 12 mm thick ordinary cement sand plaster

Single coat cement-sand plaster with cement-sand mix in proportion of 1:4 shall be carried out over the entire area as detailed above. This shall be finished just with wooden float to give the best smooth surface possible. This may be for internal or external areas. Thickness may be from 10 to 15 mm maximum or as specified in the item or drawing.

5.2 18 to 25 mm ordinary cement sand plaster

This is the same as for the 12 mm thick single coat plaster except that this shall be carried out in two coats. Maximum thickness of the undercoat shall be 12 mm and balance in the second finishing coat. All operations remain the same and are as detailed in Clause 3.0 of this section.

5.3 Cement finished plaster

This shall be carried out in the same manner as in Clause 5.1 and 5.2 of this section for specified thickness in single or double coat. Then it shall be finished uniformly over the entire area with a paste of neat cement when the plaster has just hardened and finished smooth with a steel trowel. It shall be worked over again to achieve a smooth leveled surface. Quantity of cement applied shall be about 1 kg/sqm.

5.4 Sand face plaster

5.4.1 This shall generally be carried out on the outside face and exposed area of masonry work and concrete work. It shall be of minimum 22 mm thickness and shall be in two coats (1st

coat 16 mm and 2nd coat 6 mm). The coat shall be CM 1:4 (1 cement: 4 sand) mixed with water-proofing compound in proportion specified by the manufacturer by weight of cement and applied as usual and surface shall be keyed.

5.4.2 The second coat shall be applied after 7 to 10 days and shall be of CM 1:4 (1 cement : 4 sand). Mortar shall be mixed with slightly coarse sand. Mix shall be worked over with 3 m gauge or wooden float to achieve an uniform surface.

5.4.3 The surface shall be allowed to harden sufficiently for sponging operation. Sponging shall be done by dipping sponge in cement water and removing fine particles and exposing large sand particles. The movement of sponge shall be such that no parches develop nor excessive material is removed from the surface. There shall not be a difference of more than 7 mm when checked with a 2 m long straight edge.

5.5 Water proof plaster

The water proofing compound shall be mixed with dry cement in the proportion by weight as specified or recommended by the approved manufacturer of water proofing compound. Mixing should be thoroughly well integrated with cement. Addition of water must not allow any slips of mixed cement.

The mix used, in general, shall be CM 1:4 (1 cement : 4 sand) and the balance application, curing, etc. remains the same as detailed above.

6.0 MEASUREMENT

6.1 Plaster work shall be measured in square meter to the second decimal place.

6.2 Thickness of plaster shall be the average depth of plaster as specified. But if extra thickness occurs due to bad quality of bricks, stones or blocks or due to bad workmanship, the repairs or extra thickness required to be carried out shall be at the cost of contractor.

6.3 a) Grooves, pattas in continuation of large areas or plaster areas shall be considered as part of the plaster and not measured separately.

b) Ceiling plaster, including ribbed beam slab shall be measured in square meters.

c) Beams and columns in continuation of masonry shall be measured in square meter.

6.4 Jambs, sills, coves, cornices, etc. shall be a part of plaster and no separate payment shall be made towards these items.

6.5 Deduction

a) Deduction for an opening in plaster shall not be for area less than 0.5 sq. m.

b) In case the opening area is 0.5 sq m. only 50% area shall be deducted from each face.

c) In case the width of door or window frames are equal to masonry, full area of opening shall be deducted.

d) In case of openings of area above 3 sqm each deduction shall be made for opening on each face and jambs, sifts, sills shall be measured.

6.6 Plaster to ceiling and walls shall be measured separately if specified in the BOQ.

7.0 RATE

7.1 Description of item in the BOQ. unless otherwise stated, includes, wherever necessary, conveyance and delivery handling, unloading, storing, fabrication, hoisting, all labour for

finishing to required shape and size, setting, fitting and fixing in position, straight cutting and waste, return of packings and other incidental charges.

7.2 Preparation of surface shall be as approved by the Incharge.

7.3 Trimming off the projections on masonry shall be included in the price.

7.4 Scaffolding and working platform shall be included in the price.

7.5 Materials as detailed and as required to complete item as specified shall be included in the price.

7.6 Curing of plaster shall be included in the price.

7.7 Cleaning of adjacent areas, windows, door frames, etc. including masonry surface in exposed masonry work, shall be included in the price.

7.8 Forming grooves for joints between beams/columns and masonry etc. shall be included in the price. Any special treatment if detailed shall be measured separately as billed in BOQ.

7.9 Providing and fixing chicken mesh at junction of R.C.C., brick work, edges, corners, chiseled and repaired brick work prior to plaster over concealed conduit, etc. shall be as directed by the Incharge. It shall be considered as part of item and no separate charge will be payable.

SECTION – V A

DOORS - WINDOWS AND HANDRAILS TIMBER SUB FRAMES

1.0 INDIAN STANDARDS

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies / confect noticed shall be directed to the Incharge for his direction/approval. However as a general rule more stringent specification shall take precedence.

(1)	IS 287	Recommendation for maximum permissible moisture content for timber used for different purposes in different zones.
(2)	IS 401	Code of practice for preservation of timber.
(3)	IS 733	Specification for wrought aluminium, aluminium alloys, bars, rods, sections (for general engineering purpose)
(4)	IS 851	Specification for synthetic resin adhesive for construction (non-structural) in wood.
(5)	IS 852	Specification for animal glue for general wood working purposes.
(6)	IS 1141	Code of practice for seasoning of timber

2.0 MATERIAL

2.1 Timber

2.1.1 Timber shall be of quality as specified in BOQ and well seasoned. It shall have uniform colour, be free from defects such as cracks, dead knots, soft spongy spots and waves of injurious open shakes. Grains shall be reasonably straight. The individual hard and sound knot shall not be larger than 6 sq. cm. The aggregate area of all knots shall not exceed 0.5% area of a piece.

2.1.2 All timber shall be treated with chemical wood preservatives and be kiln seasoned to IS 1141 and conform to IS 287 for moisture content. Maximum permissible limit shall be +3% for average moisture content of all samples from a given lot and +5% for individual sample of the given lot. This is applicable when thickness of timber is more than 50 mm. Small size tolerance shall be + 2% and +3% respectively.

2.1.3 Timber used shall be treated with a 10 years guaranteed and approved anti-termite treatment. Wood work in contact with masonry of concrete shall be painted with hot bitumen coaltar before being placed in position.

2.1.4 Timber received at site shall be marked and stamped for approval prior to being used at site.

2.1.5 Sizes specified are not indicative and shall be correct finished sizes within allowable tolerances.

2.1.6 All timber shall be finished to required dimension and texture prior to being treated for chemical preservation.

2.2 All nails, screws etc. Shall be hot dip galvanized or of brass or non ferrous material.

2.3 Adhesives and glue shall be as per IS for exterior quality and water repellent.

3.0 WORKMANSHIP

3.1 Timber door windows & hand rail sub frames etc.

3.1.1 Timber brought at site shall be as approved by the Incharge.

3.1.2 No timber shall be painted, tarred, oiled etc. before its inspection by the Incharge. Any effort to hide the defects by plugging, painting, etc. shall render the piece to be rejected by the Incharge.

3.1.3 All rejected timber shall be removed at once from the site of work.

3.1.4 All sawing of timber shall be done in straight lines and planes of uniform thickness.

3.1.5 All joints shall be tongued and grooved or of the type shown in the drawings specified in the item or as directed by the Incharge. All joints shall be glued with approved adhesive. Joints shall be strong, neat and shall fit without wedging or filling. They shall be pinned with hard wood or bamboo pins of 10-15 mm dia after the members of the frame are glued and pressed together in a suitable vice-mechanism.

3.1.6 Prior to joining, wood members of frame shall be planed smooth and accurate to the full depth. Rebates, roundings, mouldings, etc. as shown in the drawing shall be done before the members are joined.

3.1.7 All timber items shall be subjected to inspection by the Incharge prior to any treatment to be carried out. No. item shall be installed unless it is approved by the Incharge.

4.0 MEASUREMENTS / RATE

4.1 Door sub frames shall be measured in running metres as detailed in the BOQ.

4.2 The price for an item shall include supply of specified quantity and type of timber, sawn, cut, joined, framed and fixed in positron including supply and fixing of approved anti-corrosive treated fixtures, straps, bolts, hold-fasts, spikes, nails, screws, etc. supplying glue, coaltar, paint and anti termite treatment. The items shall also include all materials, labour, scaffolding, use of equipment, etc.

SECTION – VI

WATER PROOFING WORK

1.0 GENERAL

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the Incharge for his direction/approval. However as a general rule more stringent specification shall take precedence.

1. IS 269 Specification for 33 grade ordinary and low heat Portland cement.
2. IS 383 Specification for coarse and fine aggregates from natural sources.
3. IS 2645 Specification for integral cement water proofing compound.
4. IS 6494 Code of practice for water proofing of underground reservoirs and swimming pool.
5. IS 8112 Specification for 43 grade ordinary Portland cement.
6. IS 12118 Specification for two part polysulphide based cement: Part – I general requirements.
7. IS 13826 Method of Test.
8. IS 3495 Method of Test for Burnt clay building bricks.

1.2 Quality Assurance

1.2.1 Manufacturer's Qualification

a) Not less than five years experience in manufacturing of membrane roofing.
   1. Obtain primary materials from single manufacturer. Manufacturer's name shall appear on containers and accessories.
   2. Provide secondary materials as required by manufacturer of primary materials.

1.2.2 Applicators Qualification

a) Approved by manufacturer prior to execution of this Contract, with experience on at least five projects.

b) Foreman of Field Crew: Minimum five years experience with system of waterproofing being installed.

1.2.3 Certifications

Manufacturer's certification on manufacturer's letterhead:

1. Certify system design; penetration, transition; and perimeter details; and system specification are appropriate and satisfactory for this particular project.
2. Certify products proposed for use comply with standards.
3. Certify materials ordered and supplied are compatible with each other, suited for local and purpose intended and shipped in sufficient quantity to ensure proper timely installation.
4. Certify materials have express warranty of merchantability and fitness for particular purposes of this Project.

5. Certify manufacturer has reviewed Project and will issue warranty upon successful completion of installation.
6. Certify materials shopped to site meet membrane manufacturer's published performance standards and requirements of this Specification.
7. Membrane manufacturer's approval of insulation type and method of installation.
8. Manufacturer' s approval of installer.

1.3 Submittals

1.3.1 Product Data

Contractor to submit along with his proposal product data for material he proposes to use.

1.3.2 Informational Submittals

a) Certifications specified in quality assurances
b) Manufacturer's instructions

1.4 Waterproofing compounds

1.4.1 Waterproofing compounds shall be compendious (cement based) non-shrinking, self curing mixtures. These shall be

- ❖ Free from sodium and chlorides
- ❖ Free from material detrimental to concrete and reinforcement.
- ❖ Able to create a membrane in one or multiple coats as per manufacturer's instruction.
- ❖ Membrane capable to prevent infiltration when applied to interior faces and ponded.
- ❖ Permeability, shear bond strength, compressive strength, volume changes meets minimum requirements of codes.

1.4.2 Accessories

All other accessories materials such as primers, bonding agents, polymers etc. shall be as recommended by waterproofing manufacturer.

1.5 Warranty

A. Special Warranty:

1. Warranty with attachments for full replacement value of completed installation signed by manufacturer, applicator and Contractor warranting against water infiltration and defects of materials and workmanship for period of ten years.
2. Provide warranty that covers labour and workmanship, including labour for access to waterproofing, for watertight warranty.
   a) Warrant penetrations, terminations, changes of direction, and membrane.
   b) Warranty shall include removing and reinstalling superimposed work covering waterproofing.

2.0 MATERIALS

2.1 Cement

2.1.1 Cement shall be ordinary Portland Cement conforming to IS and shall be of grade 43 or 33. It shall be received in bags of 50 Kg and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In case cement has been stored for over 6 months or for any reasons the stored

cement shows signs of deterioration or contamination, it shall be tested as per the direction of the Incharge prior to use in the works.

2.1.2 Cement shall be stored in such locations so as to prevent deterioration due to moisture dampness. A dry and water proof shed shall be provided. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 12 bags is permitted. Stacks shall be so arranged that the first batches are used first (FIFO), and that they permit easy access for inspection and handling.

2.2 Sand (coarse sand FM above 2.25 & Fine sand F M more than 1.25)

2.2.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock is the best form of sand and shall be used.

2.2.2 Sometimes it is obtained from crushed stone screenings but often contains a high percentage of dust and clay. It tends to be flaky and angular. This type produces harsh concrete and should be avoided.

2.2.3 Sea sand shall not be used.

2.2.4 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar.

2.2.5 When tested as per IS 2386 Part I and Part II, sand shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

2.2.6 Grading of sand shall conform to IS and shall fall within limits.

2.2.7 Sand shall be stored in such a way that it does not get mixed with mud, grass, vegetables and other foreign matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the Incharge.

2.3 Brick bats (CLASS 150 AS PER U P, L N V)

2.3.1 It shall be prepared from well-burnt bricks. In no case shall under-burnt bricks be used. Flaky and elongated pieces shall be avoided. It should also be free from adherent coatings of soil or silt. Brick bats should be free from alkalies, soft fragments, organic impurities, etc. in such quantities as not to affect strength and durability of concrete.

2.3.2 Water absorption for the bricks after 24 hours immersion in cold water shall not exceed 15%.

2.4 Water

2.4.1 Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalies, acids, salts so as not to weaken mortar, or concrete or cause efflorescence or attack the steel in RCC while curing. It shall be free of elements, which significantly affects the hydration reaction. Potable water is generally satisfactory but it shall be tested prior to use in the works.

2.4.2 Water tested shall be such as to prevent any deleterious materials getting mixed with it.

2.4.3 Water shall be tested and approved in writing by the Incharge prior to use in the works.

2.5 Stone tiles such as kota / shahbad shall be of best quality and free from any defects and of uniform thickness.

2.6 MEMBRANCE

2.6.1 Synthetic elastomeric polymerized semisolid liquid and forming a film on curing.

2.6.2 Properties shall confirm to requirement as under:

1.	Material	:	Free from sodium and chlorines
2.	Chemicals	:	Not detrimental to concrete or reinforcing steel.
3.	Colour	:	Manufacturer's standard
4.	Testing Standards		
	a) Water	:	IS 3085
	b) High temperature stability	:	ASTM D-794
	c) Abrasion	:	ASTM D-968/57
	d) Salt spray test	:	IS 2074
	e) Acid / Alkali resistance	:	Unaffected over a period of 30 days by sulphuric acid solution pH 1 and sodium carbonate solution pH 13.5
	f) U.V. resistance	:	ASTM D-322
	g) Sword hardness after one week	:	50
	h) Elongation	:	20%
	i) Impact	:	25 Lb. test
	j) Abrasion Index	:	10-13

2.6.3 Accessories

Primers, bonding agents, water stops or plugs etc. as per recommendations of the manufacturer.

2.6.4 Mixes

a) Mix materials in accordance with manufacturer's instructions

b) Mix in clear containers

c) Do not re-temper mix after initial set.

2.7 Delivery / Storage

All materials shall be delivered and stored at site conforming to following minimum requirements.

- ❖ Material received is approved by Incharge.
- ❖ Material is in unopened container and labeled with manufacturer's name, brand name and instruction for use.
- ❖ Material received shall be along with manufacturer's certificate for quality and period of manufacture.
- ❖ Material shall be stored in dry, well ventilated and covered storage if so desired by manufacturer.
- ❖ Primers, adhesives etc. shall be as recommended by the membrane manufacturer.

3.0 SCOPE OF WORK

3.1 Work shall include supply, installation and test proprietary waterproofing systems to underground structure, terraces, toilet sunk slabs, water tanks etc. This shall be guaranteed for 10 years on Rs. 100/- stamp paper in proforma to be approved by the Incharge.

a) Water proofing of basement including sealing of services junctions, drain points, sumps shall be as per approved box type proprietary treatment.

b) Water proofing of terrace inclusive of grouting, sealing rainwater down takes outlets, other services outlets, junctions of walls, slab, beam, columns, parapet wall etc., where required expansion joints all as per approved terrace proprietary treatment.

3.2 Waterproofing of toilet sunk portions and water tanks inclusive of grouting, sealing, outlet pipes of services, junctions of slab, beams, walls and covering with protective cement sand plaster coat / screed.

3.3 Work shall include supply, installation and test proprietary box type system for basement and terrace system for sloped/flat roofs as approved by the Incharge. This shall be guaranteed for 10 years on Rs. 100/- Stamp paper in proforma to be approved by the Incharge.

Work shall conform to minimum standards specified. Systems detailed hereunder are to clarify type of water proofing system expected. Contractor is at liberty to suggest and submit equivalent system with products meeting / exceeding standards.

3.4 Sub Contractor / specialist shall be from the approved list and shall be approved by the Incharge in writing before being employed by the Contractor.

3.5 The Contractor shall submit

1. Statement giving detailed brief of work he proposes to carry out.

a) Name of agency with his experience certificate and quantum of work carried out.

b) Technical Specifications

c) Product data sheets of material to be used

d) Shop drawing detailing

- Sections coordinated with typical installation details
- Vertical termination and sealing
- Laps needed if any
- Typical expansion, construction and control jointing details with minimum requirement.
- Horizontal fixing and laying details.
- Typical finishing arrangement.
- Flashings if required.

e) Protective measures to be taken.

f) Installation guidance

g) Samples of each product in duplicate fixed over plywood boards or similar to enable proper cross sections.

h) Manufacturer's certificate that product and material to be used is correct and shall give intended results when applied through authorized agency.

4.0 WORKMANSHIP

4.1 Preparation of Surfaces

a) The surfaces to receive the treatment shall be thoroughly cleaned of

- Laitances, scales, loose material on surface.

- Grease, oil or other contaminants by etching with 10-15% of solution of muriatic acid using commercial grade alkaline cleaner, flushing with clean water drying and vacuuming.

b) Surfaces shall be examined and well defined cracks grouted by making 'V' groove / notches with cement slurry, shall be cured and dried well before treatment.

c) Any honeycombs shall be carefully cut and plugged, and cured well before treatment.

d) Examination of surface shall account for the fact that,

- Surfaces are cured for 14 days and no condensation has taken place.
- Horizontal and vertical surfaces have smooth finish, free from defects.
- Surfaces are dry, clean, free of grease, oil, dirt, rust, corrosion, other coatings and contaminants which could affect bond of water proofing system.

4.2 Box Type Water proofing installation

A. Stone method

It is a proprietary method. However basic steps (given below just for guide lines) are

FLOOR

1) Preparation of surface by cleaning, leveling etc.
2) 20 mm thick cement-sand-bedding mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing powder 4% by weight of cement shall be laid on surface and 20 mm graded aggregate free from impurities shall be spread on the floor. It shall be cured for 3 days.
3) Provide insert socket and pipes to release the sub soil water pressure.
4) Then 20 mm thick rough kota or similar stones of approximate 600x600 mm in size shall be laid flat over 20mm th. 1st layer mortar and joints sealed & grouted with cement slurry mixed with WPC. This shall project 300 mm all around RCC raft.
5) Then the surface shall be screened with 25mm th. cement- coarse sand-1:3 mortar and finished smooth.
6) RCC raft, walls or masonry shall be constructed as per design and standard specification.
7) The sockets / pipes are grouted with pressure.
8) Columns or any support etc. coming out of raft shall be sealed properly with aforesaid treatment / polysulphide sealant at all levels including and at top of raft / design foundation.

WALL

When walls are fully examined and prepared as detailed above, the treatment shall be

1) About 20 mm thick stone slabs shall be fixed with cement slurry grout. Grout mixed with water proofing compound 4% by weight of cement and joint 20mm thick (min) are well grouted and cured properly with 1:3 (cement : 3 coarse sand) mortar mixed with WPC.
2) External surface shall be plastered 20 mm thick with cement sand mortar 1:4 (1cement: 4 coarse sand) mixed with 4% by weight of water proof

compound with heat cement punning mixed with WPC complete at all levels as directed by E/I .

3) Vertical joint shall be well cleaned and grouted to make sure it forms a continuous treatment. If required joint may be treated with sealant.

4) Treatment shall be taken about 300 mm above finished level.

5) All pipes etc. coming out of walls shall be sealed by grouting with sealant.

4.3 Terrace waterproofing (Block bat coba - CLASS 150 AS PER U P, L N V)

4.3.1 Experienced water proofing specialists shall carry out the following or similar types of water proofing treatments. Terraces and roof slabs shall be treated with integral cement based waterproofing consisting of block coba concrete laid to slope. The treatment shall be taken over vertical surfaces as required / specified. Final finished surfaces may be laid with paving tiles, stones or finished smooth in cement and marked with false chequered marking. Points given below are just for guidelines. The actual steps and details shall be as per standard specifications and accordingly submitted by the contractor for approval of the Incharge. Work shall be carried out as per Indian standards approved method by the Incharge.

4.3.2 Surface preparation

The surface to be treated shall be cleaned and inspected thoroughly

a) All minor, medium cracks shall be marked.

b) All cracks shall be well defined and 'V' groove made. These shall be cleaned with compressed air, grouted with cement sand mortar 1:4 (1 cement: 4 sand) slurry mixed with non shrinking and waterproofing compound. Areas well cured.

c) Then again surfaces shall be well cleaned of all loose particles, laitance, moss, oil / greasy material, cement etc.

d) Roof areas shall be well marked with spot datums to create ridge, lines, slopes and drain points for easy draining of water (Nominal slopes shall be about 1:100).

e) Cement sand mortar mixed in ration 1:4 along with water proofing and non-shrinking compound as specified by manufacturer shall be mixed with clean water and layer of about 20 to 30 mm laid over the entire area to be treated; then well soaked saturated block bats shall be arranged by proper placing to create required slope as per datum established. Minimum thickness at draining point shall be 75 mm.

Rain water inlet, pipes etc. shall be well grouted; edge, corners shall be well rounded (watta) by taking up treatment about 300 mm above proposed finished level.

f) These mortar laid and bat fixed area shall be kept dipped in water for atleast 3 days.

g) Slab and roof sofits shall be examined for dampness from under. Any leakage / dampness noticed shall be treated with pressure grouting and again checked by dipping the area for 3 days.

h) When no dampness noticed, area shall be drained out and cement sand mortar mixed in ratio 1:4 (1 cement: 4 sand) shall be spread over the entire area and bats well grouted.

The top surfaces shall be finished to a neat horizontal datum level to achieve well defined ridges, gutters, watta etc. Edges shall be tucked in grooves in wall / parapet about 300 mm above proposed finished level.

i) Surfaces shall be finished / prepared to receive about 40 mm thick IPS (Indian patent stone) or China mosaic etc.

j) All expansion joints shall be cleaned, primed and finished with sealant as specified by manufacturer of sealant and approved by Incharge.

4.3.3 Products and Manufacturers

Acceptable Products:

1.	Distilment DS+ Nafufill – VV2	MC-Bauchemie (India) Pvt. Ltd.
2.	Formak 629	Aqua Alliance Agencies
3.	Tapecrete	CICO
4.	Hydro-tight	Xypex
5.	Polyakk-WP	Sunanda Speciality Coatings
6.	Mastercrete M-81	Choksey Chemicals Pvt. Ltd.

4.4 Basement Top terrace waterproofing

4.5 Experienced water proofing specialist shall carry out the above or similar types of waterproofing treatments. Terraces and roof slabs shall be treated with integral cement based waterproofing consisting of light weight Perlite brick bat coba concrete laid to slope. The treatment shall be taken over vertical surfaces as required / specified. Final finished surfaces may be laid with flooring / paving tiles, stones or finished smooth with cement.

4.5 Points given below are just for guide lines. The actual steps and details shall be as per standard specification submitted by the contractor for approval of the Incharge. Work shall be carried out as per Indian standards approved method by the Incharge.

4.4.3 Surface preparation

The surface to be treated shall be cleaned and inspected thoroughly

a) All minor, medium cracks shall be marked.

b) All cracks shall be well defined and 'V' groove made. These shall be cleaned with compressed air, grouted with cement sand mortar 1:4 (1 cement: 4sand) slurry mixed with non shrinking and waterproofing compound. Areas well cured.

c) Then again surfaces shall be well cleaned of all loose particles, laitance, moss, oil / greasy material, cement etc.

d) Roof areas shall be well marked with spot datum to create ridge, lines, slopes and drain points for easy draining of water (Norminal slopes shall be about 1:100).

e) Light weight Perlite concrete having density 450kg/Cum shall be mixed as specified by the manufacturer, with clean water and layer of about minimum 75 mm laid over the entire area to be treated; creating required slopes as per datum established. Rain water inlet, pipes etc. shall be well grouted; edge, corners shall be well rounded (watta) by taking up treatment about 300 mm above proposed finished level.

f) 4 mm thick APP Polymer modified polyester reinforced torch on membrane (Garden Moply FP 4) of STP Texsa Ltd., 16, NGN, Vaidya Marg, Bank Street, Fort, Mumbai-400 023 (Tel: 022 22664643, Fax: 022 22661730) or equivalent approved; is laid

over light weight concrete, Control and construction joint shall be reinforced with memberane strip as specified by manufacturer. All corner joints between vertical and horizontal surfaces shall be reinforced with strip as specified by the manufacturer. Expansion joints are formed as detailed and approved by structural consultant. Drains shall be sealed with proper flashings and laps as per details approved in shop drawing.

g) Slab and roof shall be examined for dampness from under. Any leakage / dampness noticed shall be treated with pressure grouting and again checked by dipping the area for 3 days.

h) When no dampness noticed, area shall be drained out and cement sand mortar mixed in ratio 1:4 (1 cement : 4 sand) shall be spread over the entire area and well grouted.

The top surfaces shall be finished to a neat horizontal datum level to achieve well defined ridges, gutters, watta etc. Edges shall be tucked in grooves in wall / parapet about 300 mm above proposed finished level.

i) Surfaces shall be finished / prepared to receive about 30 mm thick cement sand mortar screed about 30 mm thick over laid membrane and cured.

j) All expansion joints shall be cleaned, primed and finished as per specification and grouted with sealant as specified by manufacturer of sealant and approved by Incharge.

4.5 Waterproofing to water retaining structures

4.5.1 Crystalline waterproofing of Xypex or equivalent approved; waterproofing compound one / two coat shall be applied to water retaining structures.

4.5.2 Steps followed shall be as per the directions of the manufacturers and approval of the In charge. For guideline following steps may be followed.

1. Surface preparation
   Clean the surface to remove dust, loose particles and laitance.
2. Apply Crystalline waterproofing compound one / two coats at specified intervals as recommended by the manufacturer on concrete / plastered surface.
3. Protect horizontal surfaces with 30 mm thick IPS 1:2:4 (1 cement : 2 sand : 4 aggregates) laid to gradient; with adding waterproofing compound 2% by weight of cement and vertical surfaces shall be plastered with cement sand mortar in a ratio of 1:4 (1 cement : 4 sand) with using 2% waterproofing compound by weight of cement.
4. Wattas and rounding of corners, junctions with walls and floors and finished smooth and cured.
5. Curing shall be done for 7 days.

4.5.3 Treatment shall be tested by ponding water about 250 mm high for 72 hours. Surfaces shall be examined for leakage seepage, dampness, sweating etc.

4.5.4 Measurements shall be in square metre for finished surface area. Rates shall include all items right from cleaning of surface to completion and testing required against defects

such as leakage, seepage, dampness, sweating etc. and providing guarantee of employer's.

5.0 TESTING

5.5.1 On completion of installation and prior to next operation or as directed by Incharge work shall be tested by the Contractor. Required water shall be arranged and disposed of by the contractor at his cost.

a) All openings, drains etc. shall be plugged.

b) Water shall be flooded about 200 mm over the Sunk portion. Water shall be kept for 72 hours.

c) Surfaces shall be observed critically and incase any leakage is observed areas shall be treated again and tests to be carried out again to the satisfaction of the Incharge.

5.5.2 Approval of water test does not relieve the contractor of his obligation of providing installed water proofing guaranteed for 10 years as per contract.

5.5.3 All arrangement of material, labour etc. required including preserving and maintaining areas flooded shall be carried out by the Contractor at his cost.

6.0 GUARANTEE

6.1 All waterproofing systems described above are to be referred as guide-lines only. The contractor may propose the system along with his tender, giving full descriptions.

6.2 The system shall be guaranteed for 10 years against all defects and liabilities thereof from the date of completion of project. The guarantee shall be on Stamp Paper of Rs. 100/- in Performa to be approved by Employer / Incharge. (The contractor shall submit Performa to PM/ RE for approval of Employer before being written on Stamp Paper). The cost of Stamp Paper shall be to the contractor's account.

6.3 Work shall be carried through approved specialist agency as per method of working approved in writing by the Incharge.